



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

TF

25

W53

A3

625.1 W53

Western R.R.

Corporation. Engineers.

Reports of the engineers

University of Michigan

GENERAL LIBRARY

OF

University of Michigan

Presented by

Dr. S. A. Green

8/86

1900

TF
25
W53
A3

433 Red

From Dr. S. A. Green
REPORTS
Aug. 1886

OF
THE ENGINEERS

OF THE

WESTERN RAIL ROAD CORPORATION,

MADE TO

THE DIRECTORS,

IN

1836-7.

SPRINGFIELD:
PRINTED BY MERRIAM, WOOD AND CO.

1838.



123

pp. 4-65-0. 2

REPORT

UPON THE

SURVEYS BETWEEN WORCESTER AND SEVEN MILE RIVER IN BROOKFIELD.

Worcester, Aug. 15th, 1836.

TO THE PRESIDENT AND DIRECTORS OF THE WESTERN
RAIL ROAD CORPORATION.

GENTLEMEN,

In submitting for your consideration a Report upon the surveys which have been made during the present season, for a route for the Western Rail-Road, from Worcester to the valley of the Chickopee River, it may be well to premise the description of the several lines which have been examined, by a few remarks upon those features of the intermediate country, which must influence, in a great degree, the character of any, or all the routes, which connect these two points.

The waters of the Blackstone, upon which the village of Worcester is situated, are separated from those of the Chickopee, by a tract of country, elevated from 450 to 650 feet above the level of the Boston and Worcester Rail-Road at Worcester; presenting, consequently, a summit, between the tributaries of these streams, of the height just named, to be overcome by the Rail-Road.

The numerous branches which rise in this high ground, flow principally from the north to the south, and by their course indicate the general declivity of the country, as well as the direction of the ridges which lie between, or divide the waters. These ridges are of an uniform character; that is to say, they are generally broken by a succession of numerous spurs, and intervening hollows, or ravines. In many places, the spurs or ridges are composed of gravel, intermixed with stone of moderate size; and, not unfrequently, they are formed of entire rock, either Mica-slate, or Gneiss.

12-8-37 2:37
55

Our route being from east to west, or transverse to the general course of the streams and ridges, no line of any extent in that direction, either level, or of a given inclination to the horizon, can be maintained, without resorting, either to a succession of cuttings and fillings, or a constant series of curves. Keeping the difficulties in view in both cases, and avoiding either extreme, we endeavor to adopt a medium, as near as may be, depending in each instance upon the particular locality.

The declivity of the country, on both sides of the summit, in the proper direction for the route, being too great to attempt to cross directly from one valley to the other, without the intervention of inclined planes, we are compelled to deviate from the true course, and conform in a great degree to the direction of the ridges, and to attain the required elevation, by giving to the line such an inclination as may be considered admissible, viz. one which shall be fully within that upon which a locomotive engine may work effectively. Such a line cannot, of necessity, as has been before remarked, be direct in its course; it must in this be governed by the form of the ground. The general character of this portion of the line being understood, we proceed in our attempt to find the best practicable route, across from Worcester to the Chickopee.

The main ridge being sufficiently well defined, as a preliminary step, a line of levels was traced in 1835, along the same, from Charlton to Paxton, about 15 miles, in a direction nearly north, to ascertain the principal depressions. These, as is usually the case in similar situations, were found at those points near which tributaries of different streams have their sources. By this profile, Charlton Meeting-house is about 455 feet above the Worcester Rail-Road, and Paxton Meeting-house about 655 feet above the same point. From this statement it is evident that, so far as the height of the summit is concerned, we must look to the south for the least elevated ground.

The most southern of the depressions, selected for the passage of a route, is near James Ryan's, in the northern part of the town of Charlton, and about three miles north of Charlton centre Meeting-house. It lies between a branch of the French River, and a branch of the Quinebaug, and is elevated 452.41 feet above the Boston and Worcester

Rail-Road, and by the route surveyed, 13.82 miles from it. An uniform grade between the two points would give 32.77 feet per mile. By referring to the accompanying Table, (marked No. 1,) it will be seen how the grades have been established, to conform best with the ground traversed by the line.

In passing north from Ryan's summit, the next depression we have attempted is at Morey's summit, also between the waters of the French River, and those of the Quinebaug, and in the town of Charlton, but near the Spencer line. It is elevated 492.76 feet above the Boston and Worcester Rail-Road, and is 13.31 miles distant from it. An uniform grade to this summit would give 35.51 feet per mile.

Grout's summit, in the town of Spencer, is the third. It lies about $2\frac{1}{2}$ miles south of the village, and between the head of a branch of Cranberry Meadow Brook (a branch of the Chickopee,) and the French River. It is 445.75 feet above the Boston and Worcester Rail-Road; and by the valley of the French River, 13.42 miles distant, the uniform grade would be 32.21 feet per mile. Still further north, beyond the line of levels traced along the summit, and in the town of Rutland, there are two depressions, which were determined in 1835, by running a line from Worcester, to the Ware River, in Barre. One is at Bartlett's, 585 feet above the Boston and Worcester Rail-Road; and the other at Gates's, 608 above the same.

Of these summits, it will be seen by referring to the Map, that Grout's is more nearly in the general direction of the route to Springfield, than either of the others; Morey's next; then Ryan's; and that Bartlett's and Gates's are farthest from it. We will now proceed to the particular description of each route, taking Route No. 1, by Ryan's summit, as a base to which the others may be referred, in the comparisons.

Route No. 1, by Ryan's summit, represented on the general Map by a full red line, and on the sheet of Profiles, marked No. 1.

Commencing at a point about 600 feet east of the freight depot of the Boston and Worcester Rail-Road, the line passes south of J. Goddard's house, thence crossing the Blackstone canal, it passes south of G. Trumbull's, and sweeping

around the foot of Powder-house knoll, upon a curve of 2300 feet radius, it passes over the Springfield road, crossing it south of Braman's house, and thence north of Jacques's house, and barn, it falls upon the point of Goat hill; turning this hill at its northern extremity, with a radius of 2300 feet, upon a curve of 1800 feet in length, it pursues thence a straight line 2.5 miles, through the valley of Beaver Brook, across Tatnick Brook, and west of the village of New-Worcester; thence crossing the Springfield road, and the Hartford turnpike, it curves across the valley of Kettle Brook (or Blackstone River) and falls upon the side hill, near the upper part of Parkhurst's mill-pond. Following this side hill at a grade of 38 feet, the line passes into the town of Ward, and thence conforming to the general direction of the ridge (about south-west) it crosses, at Knowles's mills, a small branch of Kettle Brook, thence, pursuing the course of the side hill, it is thrown out of its proper direction, by a spur of high ground, called Henshaw ridge, which protrudes itself in a south-easterly direction; thence turning nearly west, and winding round this spur, which here forms the dividing ridge between the Blackstone and French Rivers, near L. Stone's house, the line passes into the north-east corner of Oxford North Gore; thence, lowering the grade to 35 feet per mile, and turning gradually to the north-west, to cross the valley of French River, it passes this stream a little below the Clappville lower factory, at which point it enters the south-east part of the town of Leicester; and then running south of the Church in this village, reverts to a south-westerly course, (re-entering Oxford North Gore) and continuing this direction to Station 499, towards Ryan's summit.

To diminish the quantity of filling at the French River upon this line, a second line was carried farther up the valley on the north-east side of the stream, crossing it midway of the factory pond, and, passing north of the Church, it pursues a south-westerly direction, and intersects the first route about one mile south-west of Clappville, the details of which will be found in the Table.

Resuming the first route at Station 499, the line continues to ascend to the summit, at an uniform grade of 35 feet per mile. Before reaching it, however, it is twice thrown out of its proper course—first at Captain Tucker's hill, and

again at the creek, which passes by Charlton North side, into French River. A straight line from Captain Tucker's, to the summit, would pass near the Church at Charlton north side, but to cross the creek above referred to, with an embankment, even of 50 feet, the line must pass at least three fourths of a mile north of the church. In the experimental line, which was surveyed in 1835, in a course more direct from Tucker's hill, to the summit, and passing near the Church referred to, the stream was found to be 60 feet lower than it is at the first crossing place, or something like 100 feet below the grade line of 35 feet. The profile of this line (Map No. 14,) will convey a just idea of the nature of the ground south of our line.

A line was also attempted in 1835, passing north of Captain Tucker's hill, and nearly in a direct course from Clappville towards Morey's summit. But the ground north and west of Captain Tucker's was found to be too high, and the line was abandoned, about half a mile north of said Tucker's house.

As has been stated above, the line, from Clappville to the summit, was traced at an uniform grade of 35 feet to a mile. This involves a cutting of 32.5 feet at the summit, and deep cutting for 2900 feet in length, and this will exceed 27 feet in depth, for a distance of 2500 feet. This excessive cutting suggests the alternative of raising the grade upon both sides of the summit. Accordingly, upon the east side, the grade upon 7200 feet has been raised from 35.01 to 38.88; and on the west side, from 35.29 to 38.57 for a distance of 16,360 feet. As the ground falls off in the direction of the line upon both sides of the deep cut, the effect of raising the grades will evidently be to increase the height of the embankments. The accompanying Tables will exhibit fully, the computations of the quantity of earth to be removed in both cases.

Through the cut from 723 to 756, there are two curves of 1000 feet each; the first of 1041 feet radius, the second of 1432 feet. This combination of steep grade, and the curve of least radius which occurs upon the route, appears here, to be in a great measure unavoidable.

At Ryan's summit, as in most similar situations, where streams flowing in opposite directions rise near each other, there is a swamp. This swamp is traversed by the route

about 250 feet. A pole was thrust down 12 feet without reaching the hard bottom.

At Ryan's house, which is on the summit, there is a well about 15 feet—no rock was encountered in digging it. On the southern margin of the ravine and near the route, in digging a well of 18 feet, rock was discovered. The probability is, that in going beyond 20 feet cutting, we should meet rock.

Turning from the summit, at Station 730, down, the line winds around from west to north, upon a curve of 1432 feet radius, and descending at a grade of 35.29, it crosses a branch of the Quinebaug River, flowing south; thence it falls upon the side hill, which, upon the east, bounds the valley of Cranberry Meadow Brook (a branch of the Chickopee River;) thence entering the town of Spencer, it pursues the side hill nearly north, to Watson's Brook, about 5 miles; thence turning gradually to the north-west, it crosses the Springfield road and the Seven mile River; thence turning to the south-west, it crosses the Springfield road a second time near the Spencer and Brookfield line, and terminates at Station 1132 in the road from Brookfield to Sturbridge, about half way between Gallup's mills, and the Furnace village, or East Brookfield; and by the route surveyed 21.43 miles from Station 1, at Worcester.

Route No. 2.

From No. 1 of the first route, a line was also surveyed across Racoon Plain, passing south of Powder-house hill, the Manual Labor School, and New Worcester, and intersecting the first route at Station 198. This line is 900 feet shorter than the first line. But in ascending from Racoon Plain to 198, the grade is 54 feet; and the grading would be expensive.

Route No. 2, and 1, were also connected by a line from Station 60, south of the Manual Labor School, passing on the south slope of Goat hill to No. 147 of No. 1, at the sand knoll west of New Worcester Village, near the direction taken by Mr. Baldwin, in his south route, from Worcester to the Bottomly factory. This line crossed the Springfield road near S. S. Gates's, at a point about 34 feet above the Boston and Worcester Rail-Road, or 12 feet

above our present grade line at 147. Two curves would be thus introduced—one to the north, to turn into the small ravine from No. 2—and the other south, to fall into No. 1.

It may not be amiss in this place to say, that a less circuitous and better line can be found still farther south, pursuing a branch of Kettle Brook, called Dark Brook; but it lies too low for our route. At the southern bend of Kettle Brook, nearly 4 miles from Worcester, this stream is elevated 10 feet only above the Boston and Worcester Railroad; and as we require a distance of nearly 13 miles to pass the summit at a grade of 35 feet, even, it is obvious that the line by Dark Brook would not suit our purpose, unless it might be deemed expedient to resort to fixed engines and inclined planes, to overcome the summit; in which case a route by this valley would be favorable, and a considerable portion of the whole rise might probably be concentrated at the point of Henshaw's ridge, before spoken of. This route is entitled to more notice, if taken in connexion with the Grout summit route, than it would be with that by Ryan's summit.

From Station 897 in Spencer, to 1132 in Brookfield, a line was surveyed crossing the Cranberry Meadow Brook above the red school house in Spencer, and thence pursuing the hill-side west of the Brook, it falls into the first line at 1132, as stated.

This line (marked No. 6,) is shorter than the first, by nearly one mile, and consequently descends at a steeper grade; viz. for 2.01 miles, at 50.17 per mile, and for 1.43 miles, at 34.74. The crossing of the Cranberry Meadow valley would necessitate a heavy embankment; that is to say, the present grade line is about 60 feet above it, and the width from the high ground on one side of the stream to that on the other, is 1000 feet. The accompanying Table will exhibit the amount of cutting and filling on this line, in comparison with that between the same portion of the first line. It is probable that a line located from the summit in this direction at an uniform grade of 43 or 44 feet, would present a more favorable profile, even than the present one, which was traced for a grade corresponding more nearly with that of Route No. 1.

At the crossing of the Seven-mile River by the first route, the grade is 50 feet above the stream, and the immediate

valley is 1400 feet wide. Another line was traced (Route No. 7,) crossing about 1000 feet farther south, or below, with the view of saving embankment. The grade line crosses 30 feet above, only, but the valley is 2000 feet wide. The Table will exhibit the relative amount of embankment upon these two routes.

The Routes from Clappville to Grout's summit.

The main line from Clappville to Grout's summit, is made up of portions of two distinct lines, carried upon different sides of the French River—the lower, or eastern portion being a part of Route No. 8—and the upper, or western portion, a part of No. 9. In selecting the best line for the route, it will be necessary to cross and re-cross the stream several times, as will be seen in the annexed description of each route.

In the case of Route No. 9, by the south-west side of the river, a considerable portion of the heaviest part of the embankment at the cove of the upper mill-pond, near the village, can be avoided by throwing the whole line farther south; an alternative which would *increase* the amount of cutting, but equalize, more nearly, the quantity of excavation and embankment.

From Grout's summit west, the descent to the valley of the Chickopee can be effected by two different routes—one nearly south—and the other north. To understand why we make so great a deflection from the proper course of the road, a few words of explanation are necessary.

Cranberry Meadow Brook, (referred to in the description of Route No. 1,) at a point less than one mile west of Grout's summit, is 240 feet below it. The declivity in that direction being so great, any line descending at an admissible grade for locomotive engines, must turn either to the north or south. To effect the descent within the prescribed limits, and to ascertain the direction in which it could best be made, two lines were traced—one south, by the head of Cranberry Meadow pond—and the other north, through the village of Spencer and across the Seven-mile River, one and a half miles north of the Meeting-house. The particular description of each will exhibit the details, viz.—

Route No. 8.

Leaving Route No. 1 at 448, near Clappville, a line was carried upon the north-east side of French River, crossing the Hartford turnpike east of the upper factory pond, thence across to the Baptist Meeting-house on the road from Charlton to Leicester village, thence by a straight line through the middle of Wall's mill-pond, 1400 feet, thence crossing the river to the south-west side, at the north end of Grass hill, near Sibley Converse's, and curving around to the west, it again crosses the river (or brook, as it is here,) and passing into the town of Spencer, it crosses, from 615 to 626, a swamp or meadow 1100 feet long, and varying in depth from 2 to 8 feet; thence turning the point of W. Watson's hill at Jones's mill, it continues on the north side of the brook to Watson's saw-mill, thence crossing the brook, it winds around south of west upon a very gradual curve, and pursuing a small branch of the main brook, it crosses another meadow and swamp of 200 feet in extent, of the same character as that at 615, and reaches the summit near J. Grout's house, having attained an elevation of 445.75 feet above the Boston and Worcester Rail Road at Worcester. (The Bench Mark at this summit is a point designated in Mr. Baldwin's survey of 1828.)

Route No. 9.

This is a line traced on the south-west side of French River. Leaving Route No. 1 at 462, it passes through the village of Clappville, crossing the turnpike near the tavern, thence passing over a cove of the upper mill pond upon a heavy embankment, it continues along the side hill near the road from Clappville to Leicester village, crossing the Charlton and Leicester road at Wall's mills; turning the point of a spur at this place, it continues nearly straight across a small cove of Wall's large pond or reservoir, thence falling upon the slope of Jones's hill, it unites with Route No. 8 near Sibley Converse's, and is thence identified with that route to Grout's summit.

A line in continuation of Route No. 9 from the point of intersection with No. 8, was carried around the north part

of Watson's hill, by V. Jones's, and in a direction towards Kingsley's, crossing the northern extremity of the meadow of 2000 feet in extent, referred to in Route No. 8, thence along on the side hill, and crossing the main branch of the brook, it unites with Routes No. 8 and 9, at Grout's summit. This line is 3600 feet longer than the corresponding portion of the other, with an increase of curvature, and without any improvement in the grades.

Two wells at Grout's, about 18 feet in depth, gave no indication of rock; but towards the western side of the summit it shows itself in ledges. The swamp at the summit is inconsiderable in extent, with large loose rock scattered over it.

From the summit at Station 745 (Route No. 8, towards Cranberry Meadow Pond,) the line winds around upon a curve, varying from 1432 to 2865 feet radius, and descending at a grade of 35 feet, thence it pursues its course south, on the same side hill which Route No. 1, from Ryan's summit, follows in its course to the north, thence it passes into the town of Charlton, near Newhall's mills, thence continuing still further south, about half a mile, it makes an entire semicircle, turning from the south to the north, and upon a shorter radius than occurs in any other line, viz. 716 feet, and this short turn cannot well be avoided; for an increase in the length of the radius of curvature would throw the line into very deep cutting, on the west side of the pond; continuing its course north, the route crosses Cranberry Meadow Pond, and again enters the town of Spencer, following the side hill west of Cranberry Meadow Brook, and thence by a deep cut across a neck of land, which, to be turned, would require a very short radius; and thence, to avoid a similar turn beyond, it crosses the brook twice, near the red school house, thence winding around, gradually, over broken ground, and passing several small runs, it enters the town of Brookfield, and unites with Route No. 1, at Station 1132, between Gallup's mill and Furnace Village, or East Brookfield. The distance from Worcester by this route, is 21.83 miles.

Route No. 10, by Grout summit and Spencer Village.

From the summit at 745, this line pursues a direction nearly west, half a mile, thence winds to the north upon

curves of 1273 and 1910 feet radius, descending at a grade of 30.95 feet, for 2.74 miles, to Spencer lower village; thence it continues north, on the side hill, at a grade of 55.42, for 1.57 miles; thence at 39.95; all which is detailed in the Table. At the distance of about one and a half miles north of Spencer village, it curves to the west and south, on a radius of 1900 feet, and crosses the two branches of Seven mile River; and thence by the western side hill of Seven-mile River valley, with occasional moderate curves, it falls into Route No. 1, at 1065 of the same—distance 22.04 miles.

Route No. 11,—Morey Summit Route.

This route branches from Route No. 1, at Station 558, near Capt. Tucker's hill, on the east side of the summit; thence passing over broken ground by widow Tucker's, at a grade of 34.28; thence increasing the grade to 57 feet, the line crosses, near Chamberlain's, the road from Charlton to Spencer, and thence to the summit. This summit is elevated 472.76 feet above the Boston and Worcester Rail-Road. Upon this grade, the cutting there, for 500 feet in length, would exceed 20 feet—the greatest is at Station 699, and would be 42 feet, and it would be equal to 40 feet for 300 feet in length. In descending west, the line was connected with No. 1 farther south than it should have been; the consequence is, that the grade of the road, (72.93,) upon this portion of the line, is much steeper than it would be if the two lines were connected farther north. The details are contained in the Table. A route leaving this line at Station 645, near the Charlton and Spencer road, passing north of Jones's mill, and intersecting the first route at 710, upwards of a mile west of 645, was attempted. The embankment upon this line is less than upon the first; but to obtain a grade of 45 feet it will require cutting greater than 25 feet (and at the summit 40 feet) for 2700 feet. A line diverging from the first route at 680, and intersecting it at 714, was also attempted, but without success. Still another route, further south, was attempted; it leaves the first route at about Station 600, passes through the burying ground south of Chamberlain's house, and unites with the

main line east of the summit. The filling upon this line would be excessive—at one point 90 feet.

Route No. 12, by Henshaw Ridge.

A line was surveyed in 1835, for a route, from Worcester towards Grout's summit, passing north of the other lines. Its direction was as follows. Taking our Route No. 1 to Jacques's farm, instead of turning the point of Goat hill to the south-west, it passed over north-west to Newton's hill, crossing in its route Turkey, or Mother, Brook; thence over a part of Newton's hill, it crossed Beaver Brook below Newton's saw-mill; thence turning the point of some elevated ground near C. Hardwin's, it crossed a small branch of Beaver Brook; thence curving around south-west, it crossed Tatnick Brook, one third of a mile below, or south of, Patch's saw-mill; thence winding around by P. Gates's, it fell into the meadow north of Jones's tavern, on the Springfield road, and passing through the point of the main ridge, west of Jones's, it pursued the valley of Kettle Brook, on its north side, near the Springfield road, to Bottomly's factory; and thence by Watson's Pond to Henshaw ridge, (the same that Route No. 1 *turns*, at its southern extremity, near Clappville;) crossing this ridge, it terminated in the meadow at the north end of Henshaw Pond. The total distance run over was 6.74 miles, or about one mile greater than Mr. Baldwin's, between the same points. The height of the ridge is 355 feet above the Boston and Worcester Rail-Road, giving, if an uniform grade could be adopted, 52.67 per mile. But as this cannot be effected, a desire was expressed by some gentlemen interested in the Rail-Road, to ascertain what would be the advantage to the route, by passing the valley of Tatnick Brook farther north, and, instead of crossing it below Patch's saw-mill, to ascend the stream about half a mile, by which it would be passed nearer to the grade line by 40 feet, than at the first crossing place. For this particular purpose, this might answer. But the great difficulty in this route is in rising from the meadow or swamp, north of Jones's, to Henshaw ridge; the fall in the stream itself being too great. If by crossing Tatnick Brook farther north, we gain sufficient elevation, even, to fall upon higher

ground in the valley of Kettle Brook, it would oblige us, necessarily, to make a very crooked line. Doing the best we can with this line, that is, throwing out 40 feet of the embankment at Tatnick Brook, the rise from the swamp behind Jones's to the Bench at Watson's Pond would be 100 feet; and the distance $1\frac{1}{4}$ miles, or a grade of 77.64 per mile. From the ridge to the summit at Grout's, 5.35 miles, the ascent can, apparently, be easily accomplished.

The table of inclination, and cutting and filling, upon this route, extends to Henshaw ridge only—as far as the survey of 1835 was carried.

A route was also surveyed, leaving No. 1, at Station 644, near Chamberlain's in Charlton, and thence by Jones's mill, Otis Green's, and James Green's, to the summit of the ridge near D. Hobbs's, in Spencer, and thence by an inclined plane to Route No. 6, near the red school house.

The summit, by this route, is elevated 488 feet, and will require a grade of about 80 feet per mile, to attain it from the east. The descent is about 200 feet to Cranberry Meadow Brook, and the length of the plane about 3000 feet.

This line is 1.15 miles shorter than that by Morey summit, and 2.04 miles shorter than the Ryan line.

There are three routes by which the road may enter the village of Worcester. The first is by the line described in Route No. 1. The second is by leaving Route No. 1, at Station 141, and crossing the Springfield road, north of New Worcester, thence passing over to Route No. 2, at Station 60 of the same, thence by it to the Boston and Worcester Rail-Road, east of the freight depot. The third line is by the valley of Turkey Brook, and the north end of the village.

The computations have been made upon all the lines for a width of 26 feet—slopes at the excavations and embankments of $1\frac{1}{2}$ to 1. In estimating the quantity of rock cutting, we have been governed by appearances only. Whenever it appeared in ledges at the surface, it is estimated in the table as "rock;" when in boulders, or not in place, it is denominated "loose rock." It is quite probable that we may encounter a greater amount of rock in the cuts than we have estimated for; and to provide for this contingency,

we have fixed such prices for the cutting as will, most probably, cover this item.

The estimate is to be regarded rather as comparative. The probable cost of the several parts of the line have been computed in detail; and as far as our suppositions as to the amount of rock are correct, so far may the estimate be taken as correct. But, as has been remarked, a greater amount of rock may be found in the deep cuts than we have anticipated. The truth is to be developed by boring only.

MAPS AND PLANS.

- No. 1 is a rough, general map, upon a large scale, of the country between Worcester and Brookfield, exhibiting all the lines which have been surveyed across the summit, including Mr. Baldwin's, Mr. Fessenden's, and our own.
- No. 2. Is a map containing the lines which have been approximately located during the present season—lines upon which the computations of the quantity of cutting and filling have been made.
- No. 3. Contains profiles of all the principal lines of this season, together with that of the line by Tatnick Brook, and Henshaw ridge, surveyed in 1835 by Mr. Fessenden.
- Nos. 4, 5, 6, 7, 8, 9, and 10 inclusive, are Topographical plans of the New Worcester route; Grout summit routes; the Morey summit, and the Cranberry Meadow Pond routes.
- No. 11. Contains the Ryan line, on an enlarged scale, both in plan and profile, with the cross sections of the same, exhibiting the slope of the ground transversely to the route, at each station.
- No. 12. Contains the profiles of various parts of lines, being modifications of the Ryan summit route.
- No. 13. Spencer village line.
- No. 14. Is the profile of a line surveyed in 1835, from the south part of Henshaw ridge, passing near Charlton North side to Ryan summit, by a more direct route than our line. It will serve to give a correct idea of any route between Worcester and Ryan summit, by any approximation to a *straight* line.
- Nos 15, 16, 17, 18, 19, and 20. Topographical maps of

the Ryan summit route, made by Mr. Stebbins in 1835. They exhibit a minute and accurate delineation of the ground traversed by our present route. There not having been sufficient time to complete those of this season for this report, these are submitted with this remark, that we shall have nothing better to present hereafter. They will convey a true idea of the nature of the ground which any route across the summit between the Blackstone and Chickopee must traverse.

No. 21. Profile of route No. 12, by Tatnick Brook to Henshaw ridge.

TABLES.

No. 1. Is a table containing a synopsis of the routes numbered from 1 to 12. It exhibits the length, ascents, descents, grade, excavations, embankments, bridges, culverts, and grubbing; the estimated cost of grading and bridging, for a surface width of 26 feet, upon each route, so footed, that the comparative cost and advantages of the several routes are presented. The heights and distances are all referred to the level of the Boston and Worcester Rail Road at the "Hathaway farm" in Worcester.

No. 2. Is a table of the curves upon each route, exhibiting the length of the radius, and of the curve itself, for each portion of the line in which it occurs. It also presents the aggregate length of curves of the same radius in each route.

The surveys have been executed by Assistants Stebbins and Potter, who have with untiring industry, most zealously and satisfactorily performed their several duties. Mr. Anderson has acquitted himself with his usual skill, for which he is conspicuous, in the numerous drawings illustrative of the surveys; and indeed, it is our good fortune to testify to the persevering efforts of all employed under us, to aid in the fulfilment of the duties which devolve on us.

The foregoing descriptive memoir will have sufficiently defined the localities which characterize the various modifications of the several routes, all of which, coincident as

they are, from their commencement at Worcester (with the exception of No. 12, which crosses the Henshaw ridge,) pass through the depression below Clappville, of the same ridge which divides the waters of the Blackstone and French Rivers. Thence but two general routes, in fact, present themselves, by which to effect the passage of the main dividing ridge, which separates the waters of the Chickopee from those of the French River; for the route by Morey's summit is a mere modification of that by Ryan's, suggested by the desire to avoid the deflection southward through the depression at Ryan's. It may also be added, that for the sake of comparison, we shall suppose these several routes to reunite at the red school-house in Spencer, on Cranberry Meadow Brook, and thence pursue the route indicated on the map as No. 6, to the valley of the Chickopee River; for it is obvious, whether in point of directness or cost, this route is preferable to those more north of it. We proceed, then, to the following concise illustration of such parts of the routes competing for our preference, as are involved in their comparison.

Grout Summit Route.

The objection to this route may be said to exist rather in the descent from its summit in the main dividing ridge, than in the ascent to it; for although the grade of the Rail-Road in its approach to the summit has been projected on an inclination conforming to the fall in the valley of the French River of 57 feet per mile for 1.7 miles, it is believed that this may without inconvenience, be reduced to a less exceptionable grade.

But the difficulties on the western slope are not so readily obviated; for the descent from the summit to Cranberry Meadow Brook (a tributary to the waters of the Chickopee River,) is so abrupt, that a fall of 240 feet is to be overcome in less than one mile, by an inclined plane with stationary power; or the alternative must be resorted to of distributing this descent in a circuit of upwards of 5 miles in distance, over a surface requiring rocky and expensive excavations. Nevertheless, for our present purpose, (that of comparison with the routes by either the Morey or Ryan summit,) we shall assume the alternative alluded to. The

elevation of the natural surface at the Grout summit is, as has been stated, 445.7 feet, reducible, probably, not more than 15 feet by excavation, because of the length of the cut, and the probable existence of rock at a greater depth. The length of the route from the point of departure near Worcester, to the vicinity of Gallup's mills (on the Chickopee,) is 21.9 miles, and the estimated cost of graduating the road-bed through that distance, \$602,292.

It is believed, however, that a more correct comparative view will have been presented, should we assume the quantity of rock excavation to exceed that estimated, and we shall, in preference to a less sum, suppose the total cost to be about \$635,000.

Route via Morey and Ryan Summit.

The elevation of the dividing ridge, in its passage at either of these depressions, reducible by practicable cuts, will be found to be the same as that of the Grout summit, to wit, 430 feet; and the distance by either will therefore be computed by the actual length of each, which by the Morey summit is found to be 19.56 miles; and by the Ryan summit 20.4 miles—computing, as has been stated, from the red school-house, by Route No. 6, to Gallup's mills.

The passage by the Ryan summit is to be effected (see Tables) by grades in no case exceeding 40 feet per mile; while by the Morey summit (the total elevation, and therefore the aggregate resistance from gravity being the same in both cases) we must resort to an inclination (consequent on the diminished distance, within which the elevation or descent is to be overcome) of 45 or 50 feet. The total cost of graduation will be, by the Ryan summit route, say, \$653,000; and for the Morey summit \$586,487. Or, the comparative characteristics of the three prominent routes, which we have attempted thus briefly to review, may be summarily thus exhibited:—to wit,

Rout.	Length.	Height of summit. Feet.	Grade.	Cost.
By Grout summit,	21.90	430	57	\$635,000
“ Morey “	19.56	“	50	586,000
“ Ryan “	20.40	“	40	653,000

In other respects, these routes cannot be said to differ materially; and as in both length and cost, that by Morey's summit has the advantage, and even in its maximum grades, at equal cost, it might be nearly assimilated to those required in the passage of Ryan's summit, we respectfully recommend it to your preference.

It now remains to us, however, to revert to the mode suggested of effecting the descent westward from the Grout summit, by the substitution of an inclined plane, with stationary power, for the circuit heretofore made between Station 745, at the summit, and 1035 at the red school-house, in Spencer, including a distance of 5.5 miles, the estimated cost of grading which, (a large proportion of rock excavation being necessarily encountered,) amounts to \$173,290.

Sufficiently minute surveys have not been made, with reference to this object, (for an inclined plane was not contemplated, until an analysis of the results of the surveys, within a day or two past, suggested its possible expediency,) but from the data in our possession, it would seem probable, that the cost of graduating this portion might be reduced in the sum of nearly, or quite, \$150,000, and at the same time diminish the distance, as heretofore remarked, $4\frac{1}{2}$ miles.

The cost of graduating the road-bed, therefore, on the Grout summit route, (the descent to the Cranberry Meadow Brook being effected by an inclined plane) would then be but \$525,000, and the distance but 17.65 miles; resulting in a cost of \$61,000 less than that required by the Morey summit route, and a reduction in distance of $2\frac{1}{2}$ miles; which advantages (diminished cost and distance) with that of concentrating so large a portion of the ascent from the western base to the summit of the dividing ridge, certainly would seem to claim for the route our most serious deliberation; and if, in further and more minute surveys, it shall be found practicable, within a reasonable expenditure, so to distribute the fall from the summit to Cranberry Meadow Brook, over a plane whose inclination shall permit the effective use of locomotive engines, no adequate reason occurs to us to oppose its recommendation to your preference. If, however, on the other hand, a resort to fixed, or stationary engines shall appear (as it does at present) irremediable for the whole descent, without excessive excavation on the summit, on the hypothesis that the diminished cost assumed is to be made in so short a distance that the inclination of the

plane would be in the ratio of 1 to 9—say 587 feet per mile, then sufficient considerations, resulting from the annual cost of maintaining the stationary engines, with the delay and risk of accidents on so steep an acclivity, would, in our opinion, outweigh those which we have assumed may belong to the route, and we should still feel it our duty to recommend to your adoption the Morey summit route.

In our present uncertainty, therefore, resulting from the want of adequate data to guide us with certainty to a correct conclusion, we should suggest that a decision on this most important question be, for the present, postponed; and that such farther surveys be forthwith instituted as shall suffice to dispel all doubt.

These surveys, it is supposed, may not only be made, but the line prepared for contract, so that proposals may be invited for the graduation of the Rail-Road, and its actual construction begun, on or before the 15th October. The location may also simultaneously progress beyond Gallup's mills. So that, at any rate, during the current year, 1836, the construction of the Rail-Road throughout the entire distance between Worcester and Springfield shall have been begun.

It may be well to add, that a route, not heretofore alluded to, since our present investigations began, has been surveyed, diverging from 644 of Route No. 1, and passing the Hobbs summit in a direct route across the ridge, to the red school-house; the distance by which from Worcester to Gallup's mills, would be 18.7 miles; but the approach to the summit would be difficult, and the descent from it so abrupt, as to require stationary power.

The elevation of the summit, moreover, after reducing it by a cut of 20 feet in depth, (as deep as would be expedient) would be 468 feet, or 30 feet higher than either of the other summits, which when equated, will be found to result, virtually, in an increased distance beyond that of the Morey summit route.

The Board is aware that experimental surveys are now being made beyond the town of Springfield, the results of which will be duly communicated.

Respectfully submitted,

WM. GIBBS McNEILL, CHIEF ENGINEER.

W. H. SWIFT, RESIDENT ENGINEER.

SYNOPSIS OF ROUTES.

Station.	Length.		Total length.	Ascent Grade.	Total Ascend.	Desc. of Grade.	Total De- scend.	Elev. of Grade surt. of above ground. B. & W. R. R.	Elev. of Grade surt. of above ground. W. R. R.	Grade	Excavation.			Embank- ment.	Bridge- es.	Cul- verts.	Grub- bing.	Amount.		
	Feet.	Miles.									Feet.	Earth.	Rock							Loose R.
No. 1. Ryan Summit Route.																				
From Station 1, at the Boston and Worcester R. Road at the Hathaway Farm, to Station 1132, via Clappville, Ryan Summit, and East side Cranberry Meadow Brook.																				
1.																				
53.	5300	1.004	1.004 10.	10.				10.	37.74	9.96	23,675.8	732.5		29343.9	50	230	0000	12394	70	B. & W. R. R. 600 ft. E. of Fr. Dep.
147.	9400	1.780	2.784 12.	22.				22.	22.58	6.74	53,642.3	2965.1		83822.5	75	206	4,000	29558	60	Jacques's hill.
198.	5100	0.966	3.750 38.	60.				60.	56.01	38.55	80,307.8	4638.6		83845.6	478	000		28744	70	Sand-hill west of New-Worcester.
316.8	11890	2.250	6.000 86.	146.				146.	144.37	38.55	198,990.7	21238.9	18864.4	47592.9	20	790	7000	93095	80	Junction with Route No. 2.
448.	13120	2.455	8.483 85.	231.				231.	231.01	232.56	35.01		7018.6	152550.7	40	974	3300	62481	10	Near Knowles's mills.
482.	1400	0.265	8.750 11.3	242.3				242.3	242.03	33.49	35.01			71509.4	125	238	0000	26351	50	Com. of R. 3, 8 & 10, near Clapp.
499.	3700	0.701	9.451 35.7	268.				268.	268.44	19.35	01.	26609.1	15333.3	660.1	394	237	000	30020	20	do. of No. 9, near Clappville.
558.	5900	1.118	10.569 37.94	305.94				305.94	305.94	33.41	35.01	34157.7	20822.2	33326.4	394	1000	12372	000		Junction with Route No. 2.
662.	10400	1.970	12.538 68.56	374.5				374.5	374.05	37.52	35.01	178437.9	24000.0	12881.1	293856.9	1374	1300	108606	60	Com. of Route No. 11.
730.	6800	1.388	13.826 45.50	420.				420.	420.44	35.01	151434.0	7088.3	50004.4	303	1800	46365	20	Summit.		
734.	400	0.076	13.902						435.38	35.29	37465.6			73639.9	314	1600	43206	000		Junction with Route No. 11.
790.	5600	1.060	14.962						379.90	35.55	35.29	138947.8			000	600	14466	70		Com. of Route No. 3.
809.	1900	0.360	15.322						53.	367.	384.07	35.29	57546.9		346	3300	45545	70		End of do. do.
883.	7400	1.402	16.724						49.	102.	318.	311.08	35.29	23432.0	3300	000	7815	20		Com. of Route No. 6.
897.6	1460	0.276	17.000						10.01	112.01	307.99	299.64	35.29	31261.0	1300	000	60173	20		Com. of Route No. 7.
1014.	116.40	2.205	19.205						38.39	201.	219.	233.36	39.83	120560.2	20	975	900	66086	70	Near the crossing of S. M. River.
1054.	4000	0.758	19.963						29.	230.	190.	218.42	39.83	925895.0	20	375	900	7908	80	End of Route No. 7.
1065.	1100	0.208	20.171						5.	237.	185.	197.19	22.63	48592.2	000	900	1384	70		Junction with Route No. 10.
1072.	700	0.132	20.303						2.78	237.78	182.32	174.97	22.63	50791.1	498	000	13793	70		Road at Gallup's mills.
1117.	4500	0.852	21.155						19.28	237.06	162.94	162.16	22.63	3298.1	000	000	3010	000		Sturbridge Road 1900 ft. west of
1132.	1500	0.284	21.439						5.	232.08	157.94	162.43	17.60	1420944.2	330	3057	27300	724746	60	Gallup's mills in Brookfield.

No. 2. Ryan Summit Route.

From Station 1, of Route No. 1, to Station 198 of same, passing east of New Worcester village.

1.	13000	2.462	2.462	7.5	7.5	2.	3.04	73129.0	180117.3	61754.6	1292932.9	125	7773	23.500	652048	60	B. & W. R. R. 600 ft. E. of Fr. Dep.
189 or 198.	5900	1.117	3.579	52.5	60.	85.01	53.71	119093.3	5010.	92596.4	70	308	2,700	36329	70		Kettle Brook.
1132.	17,689	31.552															Unites with Route No. 1.
																	By Route No. 1.

SYNOPSIS OF ROUTES.—(Continued.)

[illegible]

SYNOPSIS OF ROUTES--(Continued.)

[illegible]

No. 11. Morey Summit Route.

[illegible]

No. 12. Grout Summit Route.

[illegible]

TABLE EXHIBITING THE RADII OF CURVATURE AND AGGREGATE LENGTH OF CURVES IN EACH ROUTE.

[illegible]

RECAPITULATION OF TABLE NO. 1.

ROUTES.	Elev. of		GRADE.												Total length.	Total cost of Grading and Bridging.	REMARKS.		
	Sum. B. & W.	Grade above R. R.																	
			0 to 10 ft.	10 to 20	20 to 30	30 to 35	35 to 40	40 to 45	45 to 50	50 to 55	55 to 60	60 to 65	65 to 70	70 to 75					
No. 1, Ryan Summit Route.	452.41	430.	2,784	0.984	1,193	17,179										31,439	7,227,486.00		
No. 2, Ryan Summit Route.	452.41	430.	2,469	0.984	1,193	16,213											31,268	7,411,235.00	
No. 3, Ryan Summit Route.	452.41	430.	2,784	0.984	1,193	1,079	16,213										31,558	6,941,411.00	
No. 4, Ryan Summit Route.	452.41	437.5	2,784	0.984	1,193	17,179											31,439	6,704,721.10	
No. 5, Ryan Summit Route.	452.41	430.	2,784	0.284	1,193	17,354											31,514	7,108,658.80	
No. 6, Ryan Summit Route.	452.41	430.	2,784	0.284	1,193	1,439	14,316										30,454	6,633,339.60	
No. 7, Ryan Summit Route.	452.41	430.	2,784	0.984	0.984	17,362											31,354	6,979,921.60	
No. 8, Grout Summit Route.	445.75	430.	2,784	1.298	1,519	2,159	8,896	0.986	1.591								31,890	6,029,292.30	
No. 9, Grout Summit Route.	445.75	430.	2,784	1.298	1,519	1,004	9,091	2,708	1.591								31,897	6,015,623.00	
No. 10, Grout Summit Route.	445.75	435.	4,669	0.984	1,876	4,905	6,402										22,045	7,179,551.00	
No. 11, Ryan Summit Route.	473.76	435.	2,784	0.984	1,193	1,312	12,785										30,548	6,659,941.10	0.757

REPORT

UPON THE

SURVEYS BETWEEN WORCESTER AND SEVEN MILE RIVER
IN BROOKFIELD, VIA HENSHAW RIDGE, &c.

Worcester, Sept. 30th, 1836.

TO THE PRESIDENT AND DIRECTORS OF THE WESTERN
RAIL ROAD CORPORATION.

GENTLEMEN,

In obedience to the Resolution of the Board of Directors of the 24th August, directing certain additional surveys to be made, we have the honor to state that the same have been completed, and herewith we submit a Report, together with the necessary Maps, Tables, &c. exhibiting the results.

From Worcester towards Grout's Summit, two routes, in the general direction of Mr. Baldwin's line have been surveyed. The first of these we designate as No. 13, being a continuation of the numbers referred to in the Report of the 15th September. This line diverges from Route No. 1, at Station 62—it crosses from thence to the west side of Beaver Brook Valley, and pursues the hill side, towards Barnard's house; thence across to the ridge west of Jones's tavern; crossing this ridge near Williams's, and Kettle Brook near Wordsworth and Fowler's satinnet factory, it falls upon the side hill south of Kettle Brook, and continues its course up that brook by a line nearly straight, to Henshaw ridge, thence turning a little south of west, it crosses Henshaw meadow, and falls upon the main Leicester ridge; pursuing the foot of this ridge, until it turns it at Livermore's, thence it regains a course corresponding more nearly with the proper direction of the route; and crossing the Saddler meadow, and a part of Haven's saw-mill pond, it continues

by Kingsley's and falls into Route No. 8, at Station 602 of the same.

The second of these lines, (Route No. 14,) leaves the Boston and Worcester Rail Road at Station 0, passing south of Powder House Hill, and the Manual Labor School, it crosses the Springfield road, near S. S. Gates's, and thence descends 19 ft. to Tatnick Brook valley; thence pursuing its course west, it crosses the Ryan summit line (Route No. 1,) at the sand hill, near New-Worcester; thence, instead of crossing the ridge north and west of Jones's tavern, it passes in front or south of his house, and turns it; crossing the Bottomly factory stream near Eldridge and Parson's woolen factories, it continues by the south side of the same, to Station 226 of Route No. 13, before referred to, from thence to 602 of Route No. 8, it is the same as Route No. 13. The description of Route No. 8 from Station 602 above mentioned, to Grout's summit, will be found in the report of 15th September.

From Grout's Summit west, towards Brookfield, two lines were carried down in the general direction of Mr. Baldwin's, and three others were attempted in other directions. The best of these has been selected to make the computations upon. It is represented in the accompanying profile, and numbered Route 13. This line passes down from the summit towards Jesse Bemis's, south of whose house it crosses the Spencer road; thence turning a point of the rocky ridge, N. W. of Bemis's, it follows the side hill and descends at a grade of 79.20 to Sylvester Luther's; at this point it is thrown out of its course by the prominent hill north west of Luther's house; thence it passes north of the hill upon which Warren Livermore resides; thence turning to the south west it descends to the valley of Seven Mile River, near to its junction with Cranberry Meadow Brook; from thence at a moderate grade, it follows the general course of the stream, crossing it three times, to avoid unnecessary curves, and terminates near Station 1132 of Route No. 1, in the Sturbridge road, west of Gallup's mill.

No. 15.—Route by an Inclined Plane from Grout's Summit to the valley of Cranberry Meadow Brook.

The rocky ridge north west of Jesse Bemis's, referred to

in the description of the last route, prevents, effectually, the passage of a line from Grout's Summit, in the direction of the Seven Mile River; and the only practicable line by which the descent by an inclined plane is to be effected, is by the valley of Livermore Brook; this is a branch of Cranberry Meadow Brook, and flows in a direction about west south west. The course of the latter stream being here nearly north, a great deflection at the foot of the plane is obviously the consequence, viz. something like 120° . Were it not for this circumstance, the plane could be carried quite down to Cranberry Meadow Brook, and by this disposition, the whole descent would be effected. To obviate the difficulty of introducing an abrupt curve at the foot of the plane, it is necessary to begin to deflect before reaching Cranberry Meadow Brook; and at the same time, it is, for a similar reason, also necessary to throw the line upon the side hill west of this brook. The plane itself is straight, 3800 ft. in length, and descends at a grade of 194.50 per mile. At the foot of the plane the curve of 1041 ft. radius commences; thence for a distance of 7300 ft. the grade is about 86 ft. per mile. From thence to Station 1132 of Route No. 1, nearly two miles, the whole descent is but 10 ft. This line unites with Route No. 13 near the junction of Cranberry Meadow Brook, and Seven Mile River.

The accompanying Tables, marked A. and B. will exhibit every detail of these three routes—length, grade, cutting, filling, cost, &c. &c. For the present purpose, it will be sufficient to enumerate here the essential points to be considered in the comparisons which are to be made.

Route.	Length in miles.	Max. Grade. Feet.	Cost.
Morey Summit Route by No. 1, 2, 6, & 11.	19.46	50.00	\$588000.00
Route 13, N. of Jones's Tavern, Henshaw Ridge, &c.	15.69	136.12	472412.10
" 14, " " "	15.67	111.53	427114.30
" 15, (Inclined Plane) and No. 14 combined.	15.46	194.52	404721.30

Referring to the general table, it will be seen that upon Route No. 14, there is 1.68 miles of this line, on the east side of the summit, which ascends 111.53 per mile, and when we state that the whole length of the line to Brookfield is about the same as Mr. Baldwin's, it may be asked why the grade of 80 ft. had been exceeded in ours, while

in Mr B.'s it did not in any case go beyond it. The answer to this is obvious, viz. the necessity of introducing, upon a line of this great acclivity, the smallest possible number of curves. The resistance produced by the curves on a level road may evidently exceed that which is effected on an inclined plane by gravity; even on a plane elevated 100 ft. to the mile. In comparing these lines, therefore, it is quite as necessary to examine the *plan* as the profile.

On the west side of the summit, by making the line more crooked than it now is, the grade may be kept within 80 ft. In our present line it exceeds that amount. In assuming 80 ft. per mile, the succession of curves (which it is impossible to avoid in the descent west,) will increase the resistance, quite as much, or more, than an increase of 10 ft. in the grade, together, (on both sides of the summit) say equal to an inclination of 100 ft. per mile.

In comparing Routes No. 1 by Morey Summit, and No. 14 by the Bottomly factory and Henshaw ridge, to Grout's summit, we arrive at the following results. No. 14 is 3.81 miles shorter than No. 1, and it will cost to grade it, say \$161,000, (or including superstructure) \$199,000 less than No. 1. It has, however, 7.72 miles exceeding 80 ft. per mile; while the line by Morey will have no grade exceeding 50 ft., and even at that inclination, it will have but 4.79 miles. No. 14 will have two grades on the east side of the summit descending to the west, of 19 ft. and 25 ft. each,—making together 44 ft. and this being equated at 18 ft. (the slope which requires double the power required on a level road,) results in a virtual increase of nearly 2.5 miles; or in other words, it adds 44 ft. to the height of the summit, and thereby diminishes the difference in the length of these two lines to 1.3 miles.

We shall now exhibit the load of an Engine upon planes of various inclinations, from 0 to 100 ft. per mile.

We will suppose an Engine weighing 10 tons to be capable of propelling a load of 260 tons (tender included) on a level; the load of this Engine upon any inclination will be thus expressed:—

$$L = l - \frac{(E + 2)g}{g + f}$$

L = Load on plane in tons.

l = Load on level in tons.

E = Engine in tons.

g = Gravity per ton on plane in lbs.

f = Friction of load per ton in lbs.

From the above formula we deduce the value of L , or the load in tons, with which this Engine is capable of ascending upon planes, varying in inclination, from 0 to 100 ft. per mile—the rails being in the best state, or the adhesion $\frac{1}{4}$.

Level, tons.	ft. 10 t.	ft. 20 t.	ft. 30 t.	ft. 40 t.	ft. 50 t.	ft. 60 t.	ft. 70 t.	ft. 80 t.	ft. 90 t.	ft. 100 t.
360.00	173.58	128.95	101.87	83.60	70.04	60.53	52.83	46.60	41.50	37.25

When the rails are wet, or frosty, the adhesion may be diminished to $\frac{1}{8}$; the load in this case is also diminished in the ratio of $\frac{1}{4}$ to $\frac{1}{8}$; or upon a level, the load would be but 78 tons; on 50 ft. per mile, 16.21 tons; on 100 ft. do. 5.40 tons.

We must now consider the cost of maintaining the additional power necessary to be provided, if the shorter route should be adopted. We may safely assert, that not less than two assistant engines will, at all times, be required—one on each side of the summit. On the Liverpool and Manchester road, at the two planes of $\frac{1}{8}$, and $\frac{1}{9}$, equal to 59 ft. and 55 ft. respectively, the freight trains are assisted by additional engines, placed there for the purpose. On that road they have thirty engines, of this number, 10 are in daily use, an equal number in the shop undergoing repairs, and the balance laid aside, being of the older patterns, and less effective than those now made.

On the Worcester road they have 9 engines, one third of which are at all times in the shop. Hence to have the two additional engines at the summit constantly fit for service, we must be provided with three.

The actual cost of keeping 10 engines in constant order, on the Liverpool and Manchester road, for the year ending 30th of June 1834, exclusive of the expense of running them, was £18,300, or for each, about \$8,200.

On the Worcester road the actual cost of repairing and running 6 engines for the year ending 30th June, 1836, was

\$30,690, or, including the interest upon the cost of the stock, \$34,470; or for each, \$5,745.

Cost of 3 engines of a larger size than those generally used, say 10 to 12 tons, at \$9,000 - - - - \$27,000

Interest upon the same - - - - - 1,620

Upon a road of grades of 80 feet and upwards, the wear and tear of the engines would be far greater than upon either the Liverpool and Manchester, or the Worcester, from the necessity of using the brakes so frequently upon the descents; the effect of which, it may be incidentally remarked, is quite as injurious to the road, as to the engines. We shall therefore assume \$6,500 as the cost of maintaining the engines in repair, and of running the same, and this is only about three fourths of the cost of the repairs alone, of those of the Liverpool and Manchester road.

Cost of repairing and running 2 - - - \$13,000

Interest upon cost of 3 - - - - 1,620

Total cost of 2 (effective) - - - \$14,620

And this is the interest of \$243,660, or upon \$44,360 more than the cost of the additional 3.81 miles, by the Morey summit route. And while to the Corporation, the cost of transportation would be about the same, the sum received for tolls, on the short line, would be only $\frac{1}{4}$ of that upon the longer line.

It will be seen from what has been said, in relation to these two routes, that notwithstanding the distance gained by that through Grout's, and the consequent diminution of first cost in the construction, the total expenditure for power, on each route, will very nearly equalize the cost of construction and transportation, on each route. And when we take into consideration the practical difficulties of applying power upon steep grades, the maintaining it always with certainty, and the great danger of impairing the confidence of the public, in the safety of this mode of travel, from the greater liability to accident, and the more serious consequences resulting from accidents upon the steeper grades, we cannot but believe that your Board will coincide with us, in the preference we continue to give to the route by Morey's summit.

Computations have been made at the request of some members of the Board, to ascertain the cost of grading the

road from Worcester to Ryan summit, upon an undulating line, or upon a line with ascending and descending grades of 80 feet. The difference of cost between such a line as we are about to describe, and that upon which the first estimate was predicated, will be about \$150,000. This is undoubtedly a large sum to be saved, in grading a piece of road of only 14 miles in extent. But there are so many disadvantages attending a road constructed upon this principle, that the great saving in cost becomes, comparatively, a small consideration. It is proper to remark, that the calculations of the cost of grading this line, are made upon the supposition that the fillings are to be diminished in the same manner that it is proposed to reduce the cuttings; or in other words, that the undulations are carried both above and below the uniformly ascending grade upon which the first computations were made.

If, as in the case of the route by Ryan summit, we adopt a line, say, in no instance exceeding 40 feet per mile, but generally at 35 feet, and undulating upon it in such a manner that the grade shall never fall below this line; then the height of the summit will be increased, virtually, by an amount equal to the total sum of descents, viz. 138 feet. But as the object of grading the road upon this principle is to save expense in the cost of construction, and upon this line the cuttings and fillings being nearly equal, that is to say, they are in the ratio of 1 to 1.04, we should, to derive all the benefit from it in this respect, which this mode is susceptible of yielding, extend the grade below the line before referred to, in such a manner, that the quantity of fillings may be diminished, as well as that of the cuttings, if it is carried below, the amount of the descents will be increased 231 feet, and equating these two sums, 138 feet and 231 feet at the rate of 18 feet per mile, we find them equivalent to 7.68 miles, and 12.83 miles, respectively, or enumerating them thus:

Upon the lesser, and constantly ascending grade 13.82 miles.

Undulating above the uniformly ascending grade 21.47 "

" above and below " 26.65 "

or, in other words, the cost of transportation upon this line, by these three modes of grading, will be to each other, as 1 :: 1.55 :: 1.92, 1 being the lesser and uniformly ascending grade. This must hold true, unless the engines

were permitted to exert their whole power, uniformly as well on the descents, as on the ascents, of the undulating planes, but this could not be allowed, for in practice there are many circumstances, which limit the speed of an engine, both in reference to safety, deterioration of the machinery, and the difficulty of arranging the slides for extreme velocities; or rather of suiting them to the variable velocities, which such a system would render necessary. For these reasons, it has never been considered expedient to calculate upon a velocity, on a descending plane, greater than that which might be permitted upon a level, with safety; and upon such steep planes as 80 feet, not even so great. But in order to compensate for the loss of time in ascending, the velocity required to produce this effect on the descending planes, would be entirely inadmissible; therefore the difference of time in descending by the regulated velocity, and that which would be required to compensate for the loss of time in ascending, would be lost on the undulating line.

A very serious objection to this principle of grading, is to be found in this, viz. the route across the summit, in addition to its grade of 40 feet, is necessarily a crooked one, and in order to overcome the total resistance, it is essential that the curves be diminished to the greatest extent practicable. In doing this, we are very often obliged to encounter deep cuts, at the points of the ridges and spurs; and it is at these places that many of the *deepest* cuts will be found. Applying the undulating principle at these points, and thereby increasing the grades to 80 feet, they might, added to the curves, present a combined resistance, too great, in many cases, for the power of the engine to overcome.

In another view, the objection is equally serious. The practical difficulty of working an engine upon such a line would be exceedingly great. To those who have examined the subject, it is known that the engine works to very great disadvantage when the velocity has to be constantly changed; and to work effectively, it is previously regulated for a *particular* velocity, and the valves arranged accordingly. It is not simply the question of letting into the cylinders a greater or less quantity of steam; but it is in adapting what is technically called the lead, to the velocity which it is designed to travel with. This lead is different in

amount for different velocities. A certain velocity is necessary to generate steam; of course this velocity would be attained in the descents; but evidently it would be unsafe to give the engine such a load as might reduce the speed on the ascents below that which would be required to produce steam.

To one who has travelled upon roads with steep grades, the truth of this remark must be known—he must have occasionally witnessed the entire stoppage of the train.

After giving to the subject the mature consideration which its importance demands, we are fully of the opinion, that nothing has been developed by the recent surveys, which justify us in changing the opinion we expressed in the last Report, and we now respectfully reiterate that we consider the route by Morey summit entitled to your preference, and accordingly recommend that it be adopted.

The accompanying Tables (A. and B.) contain a synopsis of routes 13, 14, and 15, referred to in the above Report. They exhibit every detail, necessary for a comparative view of the several routes. The former contains the length, grade, excavation, embankment, cost, &c. of each. The latter contains the length of each curve, with the length of the corresponding radius.

WM. GIBBS McNEILL, }
 GEORGE W. WHISTLER, } ENGINEERS.
 W. H. SWIFT, RESIDENT ENGINEER.

In a number of the first impression the formula at page 31 is erroneously printed, it should be

$$L = l - \frac{(E + l)g}{g + f}$$

SYNOPSIS OF ROUTES.

Stations.	Length.		Total length.	Ascend. of Grade.	Total De- scend.	Elev. of		Excavation.		Embank- ment.	Bridg- es.	Cut- vert.	Grub- bing.	Amount.
	Feet.	Miles.				Grade above ground B. & W. R. R.	Grade. Per Mile.	Earth.	Rock.					
No. 13. Route by Henshaw Ridge to Groat Summit.														
0														
53	5300	1.004	1004	10	10	10	37.74	9.96	23675.8	739.5	29343.2	230		12394.70
149	9600	1.818	2.822	30	40	40	41.84	16.50	156148.6		115228.2	378		48765.60
213.79	6479	1.227	4.049	165	205	205	202.66	136.12	265967.5		27479.6	366	600	84985.50
232.79	1900	0.359	4.408	5	210	210	210.59	13.89			1888.3	64	650	6640.30
302.79	7000	1.325	5.733	110	320	320	317.38	82.98	103118.0		8178.0	752	1000	34315.30
327.79	2500	0.473	6.206	22	342	342	343.13	46.46		1088.0	14020.6	176	1700	4549.80
421.79	9400	1.760	7.986	18	360	360	360.53	10.11		3077.0	167951.5	374	2700	68933.60
451.79	3000	0.568	8.554	15	375	375	388.20	26.40	46099.0		11908.7	500		15086.70
479.53 or 609	2774	0.595	9.079	25	25	350	345.50	48.00		29944.9	29944.9	82		9950.50
609 to 655	4600	0.871	9.950	50	425	400	407.25	57.39	6904.3		2155.4	142		16151.40
709 or 745	5400	1.020	10.970	30	455	430	445.75	29.33	27697.4		1833.2	490	300	18152.50
805	6000	1.136	12.106	90	115	350	358.36	79.20	24305.1		33596.7	466		31047.60
870	6500	1.231	13.337	100	215	250	255.83	81.23	75756.2		4594.1	70	500	41955.20
925 or 914	5500	1.041	14.378	95	313	152	155.13	94.08		2640.0	69102.4	266		23529.50
926	1200	0.227	14.605	2	315	150	145.38	8.80			911.8			3547.20
983.5	5750	1.089	15.694	0	315	150	150.00				20198.0	68		28106.70
									1805652.4	58969.6	58774.8	3924	7950	447412.10

SYNOPSIS OF ROUTES—(Continued.)

Stations.	Length.		Ascent of Grade, Feet.	Total Grade, Ascent.	Desc. of Grade, Feet.	Total Dist. ascnt.	Elev. of Grade sur. of above ground B.W. ab. B. & R.R. W.R.R. Mile.		Excavation.	Embankment.	Bridge- es. Feet.	Cul- vers. Per- ches. Feet.	Grub- bing. Feet.	Amount.
	Feet.	Miles.					Feet.	Miles.						
709 or 745														
760.	1,500	10.949					430	445.75						
760.	1,500	0.284	11.233		10	10	430	425.52						
798.	3,800	0.719	11.952		140	150	280	281.88	194.52	35.20	397,541.3	358,945.5	22,691.2	68,644.8
833 or 821	3,500	0.682	12.614		56	206	284	210.53	84.48	588.8	151,764	161,058.0	238	350
871.	3,800	0.719	13.333		64	270	160	157.99	88.92	582.33	52,533.6	140,243.6	248	1,400
926.	5,500	1.041	14.374		10	280	150	145.38	9.60	6257.6	97,380.7	174,133.30	216	9,200
983.5	5,750	1.089	15.463				150	150.00		874.6	811.5	251,067.70	65	251,067.70
							150	150.00		201,95.0	33,550	108,363.79	220	84,0718.1
										1,459,90.3	23,691.2			

RECAPITULATION:

ROUTES.										GRADE.										REMARKS.	
Elev. at Elev. of Summit Grade at above					B. W. R. W. R.					Cost of Grading and Bridging.										REMARKS.	
From Sta.	To Sta.	Radius.	Cur.	Ft.	From Sta.	To Sta.	Radius.	Cur.	Ft.	0 to 10 ft.	10 to 20	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100		Total Length, Miles
Table exhibiting the Radii of Curvature, and the aggregate length of Curves, in each Route.																					
Recapitulat on.																					
No. 13. By Henshaw Ridge.																					
1	5	1146.	500	379	382	1432.5	300	885	543	1041.5	1800	149	154	1432.5	500						
26	31	2292.	500	382	393	955.	1100	844	853	1041.8	900	191	199	5730.	800						
70	83	265.	1500	473	450	2865.	700	866	897	1432.5	3100	205	209	2865.	400						
103	112	3820.	900	609	612	1637.	700	888	902	1432.5	400	215	22	1910.	600						
155	167	5730.	1200	626	632	2329.	600	905	920	1432.5	1800	225	232	1432.5	800						
190	198	2865.	800	681	668	1432.5	700	932	951	2865.	1800										
296	308	5730.	1200	680	687	2356.5	700														
323	328	5730.	500	762	766	1146.	400														
328	339	1910.	1100	771	784	716.2	1300	151	251	5730.	1000	757	762	1910.	500						
332	360	3890.	800	796	802	955.	600	65	69	1432.5	300	856	869	1432.5	1300						
371	379	3820.	800	803	812	1146.	900	126	132	1432.5	600	892	931	2865.	1900						
No. 14. Route by Henshaw Ridge.																					
No. 15. Route by Inclined Plane.																					
No. 16. Route by Inclined Plane.																					
No. 17. Route by Inclined Plane.																					
No. 18. Route by Inclined Plane.																					
No. 19. Route by Inclined Plane.																					
No. 20. Route by Inclined Plane.																					
No. 21. Route by Inclined Plane.																					
No. 22. Route by Inclined Plane.																					
No. 23. Route by Henshaw Ridge.																					
No. 24. Route by Henshaw Ridge.																					
No. 25. Route by Inclined Plane.																					
No. 26. Route by Inclined Plane.																					
No. 27. Route by Inclined Plane.																					
No. 28. Route by Inclined Plane.																					
No. 29. Route by Inclined Plane.																					
No. 30. Route by Inclined Plane.																					
No. 31. Route by Inclined Plane.																					
No. 32. Route by Inclined Plane.																					
No. 33. Route by Inclined Plane.																					
No. 34. Route by Inclined Plane.																					
No. 35. Route by Inclined Plane.																					
No. 36. Route by Inclined Plane.																					
No. 37. Route by Inclined Plane.																					
No. 38. Route by Inclined Plane.																					
No. 39. Route by Inclined Plane.																					
No. 40. Route by Inclined Plane.																					
No. 41. Route by Inclined Plane.																					
No. 42. Route by Inclined Plane.																					
No. 43. Route by Inclined Plane.																					
No. 44. Route by Inclined Plane.																					
No. 45. Route by Inclined Plane.																					
No. 46. Route by Inclined Plane.																					
No. 47. Route by Inclined Plane.																					
No. 48. Route by Inclined Plane.																					
No. 49. Route by Inclined Plane.																					
No. 50. Route by Inclined Plane.																					
No. 51. Route by Inclined Plane.																					
No. 52. Route by Inclined Plane.																					
No. 53. Route by Inclined Plane.																					
No. 54. Route by Inclined Plane.																					
No. 55. Route by Inclined Plane.																					
No. 56. Route by Inclined Plane.																					
No. 57. Route by Inclined Plane.																					
No. 58. Route by Inclined Plane.																					
No. 59. Route by Inclined Plane.																					
No. 60. Route by Inclined Plane.																					
No. 61. Route by Inclined Plane.																					
No. 62. Route by Inclined Plane.																					
No. 63. Route by Inclined Plane.																					
No. 64. Route by Inclined Plane.																					
No. 65. Route by Inclined Plane.																					
No. 66. Route by Inclined Plane.																					
No. 67. Route by Inclined Plane.																					
No. 68. Route by Inclined Plane.																					
No. 69. Route by Inclined Plane.																					
No. 70. Route by Inclined Plane.																					
No. 71. Route by Inclined Plane.																					
No. 72. Route by Inclined Plane.																					
No. 73. Route by Inclined Plane.																					
No. 74. Route by Inclined Plane.																					
No. 75. Route by Inclined Plane.																					
No. 76. Route by Inclined Plane.																					
No. 77. Route by Inclined Plane.																					
No. 78. Route by Inclined Plane.																					
No. 79. Route by Inclined Plane.																					
No. 80. Route by Inclined Plane.																					
No. 81. Route by Inclined Plane.																					
No. 82. Route by Inclined Plane.																					
No. 83. Route by Inclined Plane.																					
No. 84. Route by Inclined Plane.																					
No. 85. Route by Inclined Plane.																					
No. 86. Route by Inclined Plane.																					
No. 87. Route by Inclined Plane.																					
No. 88. Route by Inclined Plane.																					
No. 89. Route by Inclined Plane.																					
No. 90. Route by Inclined Plane.																					
No. 91. Route by Inclined Plane.																					
No. 92. Route by Inclined Plane.																					
No. 93. Route by Inclined Plane.																					
No. 94. Route by Inclined Plane.																					
No. 95. Route by Inclined Plane.																					
No. 96. Route by Inclined Plane.																					
No. 97. Route by Inclined Plane.																					
No. 98. Route by Inclined Plane.																					
No. 99. Route by Inclined Plane.																					
No. 100. Route by Inclined Plane.																					

REPORT

UPON THE

EXPEDIENCY OF GRADING THE ROAD FOR A DOUBLE TRACK.

Worcester, December 20th, 1836.

THOMAS B. WALES, Esq., PRESIDENT OF THE WESTERN
RAIL ROAD CORPORATION.

SIR,

Your communication of the 12th November, calling upon the Engineers and Resident Engineer, for an opinion upon the expediency of constructing the First Division of the Western Rail Road for a single track was duly received.

It was intended to postpone a reply to this communication until the Report for the January meeting of the Board was prepared, and to state in it, fully, the disadvantages, which we conceived would arise if the order of the Board of 4th October, directing the road to be graded for a single track were adhered to, but upon further reflection, we have considered it our duty to anticipate the period of the Directors' meeting, in order that sufficient time may be afforded for the members of the Board to consider the reasons, which we deem it proper to offer against the proposed width for the track.

The order specifies that the cuttings shall be from 14 to 20 feet in width, and the embankments 12 feet at the surface.

We propose in the first instance to consider the subject in respect of the cost alone, intimating, respectfully, at the same time, that in our opinion the question should be treated independently of cost, upon the ground that the road should be graded for a double track, even if it be not intended to lay down more than the single track—and this for the reasons which we shall assign in their place.

The road being graded for a single track, the rails of course would be laid upon the middle of the bed, and not upon the side, as in the case of a bed for a double track; this being the case, we shall assume that the road bridges and stream bridges are to be of a width sufficient for two tracks, for the well known reason, that the expense of removing the wing walls, for the purpose of widening the abutments hereafter, would be greater than the cost of making them the full width in the first instance. The culverts we may make conformable with the width of the embankments, as they may be extended for a double track at any subsequent period without much additional expense. We shall further state that the maximum width authorized for the cuts (20 feet,) is barely sufficient to afford space for the ditches necessary to drain the road.

Upon these premises, we proceed to exhibit the difference in cost between the double and single track.

In level cutting, when the depth of the cutting (or filling) amounts to $\frac{2}{3}$ the width of the surface of the road, the areas of the sections of the slopes become equal to that of the bed. The cost in that case, therefore, of the bed and of the slopes will be equal. If the depth of cutting be greater than two thirds-the width of the surface of the road bed, the ratio of expense is a decreasing one. If the cutting be less than $\frac{2}{3}$, the converse is true. Take, for an example, two widths, say 15 and 30 feet, and depths of 10 and 20 feet,



here the depth is $\frac{2}{3}$ the surface width, and the slopes contain the same quantity of earth which the bed itself contains.

Now take two other cases in which the widths shall be the same as in the former case, but the depths different, say widths, 15 and 30, and depths of 5 and 30, in this the depth in the first example, is $\frac{1}{3}$ less than is required for equal expense, and in the second it is $\frac{1}{3}$ more, and the ratios are 37.5 : 75 and 1350 : 900; that is, in the first case the bed costs twice as much as the slopes, and in the second it is only $\frac{2}{3}$ the cost of the slopes, hence for heavy work, similar in character to that upon the first division, the ratio is in favor of the double track.

We shall further premise, that twelve feet for the embankments (the width ordered) is too narrow for safety at all times, and too narrow to admit of being worked without great loss of time. We shall assume 16 feet as the least admissible width, even for the narrow track.

Taking Sections 10, 11, 12 and 13, embracing about 4 miles of the road, we shall exhibit the gross amount of cutting and filling upon each, with the cost of the same at the prices at which the contracts are made—both for double and single track.

SECTION 10.

Width track.	Cutting.	Filling.	Cost.	Difference.
20 and 16.	33684.7 yds.	42729.7 yds.	9827.67	2798.18
26 and 26.	39209. "	54895. "	12625.85	or 23 per cent.

SECTION 11.

20 and 16.	52772. yds.	59801. yds.	20930.35	3765.67
26 and 26.	60472. "	70560. "	24696.	or 15 per cent.

SECTIONS 12 AND 13.

20 and 16.	172755. yds	183641. yds.	89984.09	6945.91
26 and 26.	194400. "	215400. "	96930.00	or 8 per cent.*

The average of the difference in cost, as above, is about 15 per cent. We shall assume $\frac{1}{3}$ to $\frac{1}{4}$ as the additional cost of grading the road for a double track throughout the division. The total difference upon this hypothesis, for the 19 $\frac{1}{2}$ miles will be about 75,000 dollars; upon the supposition also of all the excavations being earth, and earth and loose rock, in the proportions estimated in the four above named sections. In the case of a rock cut, there being but an inconsiderable slope to be given to the sides, the expense of the cuts would be nearly in the ratio of the widths, or 26 : 20, say 23 per cent.

* In consequence of some modifications made in the grades of the line across the summit, the amount of cutting and filling as stated in the above table is less than the quantity furnished by the final computations upon the established line. This does not affect the principle, however. The comparative results are all which we are desirous of presenting to your notice at this time.

The contractors in their proposals for executing the work, have made a difference in favor of the double track, of from one to four cents per yard for earth, from $2\frac{1}{2}$ to 10 cents for loose rock, and from 5 to 30 cents for solid rock.

It remains to us now to state such objections to the width (as at present ordered) as appear to us obvious. They may be thus summarily enumerated.

1. The difficulty and disadvantage of working any amount of force either in the cuts, or upon the embankments, particularly the latter, 12 feet in width not allowing sufficient space for the carts to turn or pass each other without liability to accident, the carts being $6\frac{1}{2}$ feet at the axles, and the embankment but 12 feet, the consequence in the manner referred to is obvious. We may add in this place the proof of this by stating that even now, the carts upon the only embankment which is carried out, have been precipitated some half dozen times while turning or passing each other.

2. The embankments being constructed, and in places rising from 20 to 60 feet in height, with a surface width of 12 feet only, what might we expect their condition to be at the end of a season—affected as they must be by the action of the frost, and washed into gullies by heavy rains? They might, by the effect of single storm, be rendered impassable.

3. In the event of an accident to a train of cars upon an embankment, by which they should be thrown off the rails, *some* space is necessary to work, in order to replace them upon the track; and while this may probably be done if they are not broken, what is the alternative if they are, say a wheel?—there is no room upon either side of the track for them to remain for another train to pass, but must effectually stop the passage of every thing, until they can be removed from the bank, by being lowered perhaps into a swamp or ravine, from which it may be equally or more difficult to get them again upon firm ground.

4. It has been said that if these difficulties occur, and the narrow bed is proved to be too inconvenient, that the track may, at any subsequent period, be widened, and at a less expense, even, than in making it sufficiently wide for a double track in the first instance. The great difficulty, and

we might say impracticability of this proceeding, is too evident to any one having the least knowledge of the matter, to require an answer. We might take for an example the rock cut on the Worcester Rail Road, and ask, in increasing the width of the track at that place, what might and probably would be the effect of a single blast? It requires but little reflection to answer, that the road might, at any moment be rendered impassable, and in such a manner, that all the force within the control of man could not remove the obstacle in 24 hours. The road being graded for a single track, the rails of course would be laid in the middle of the graded surface; the whole would of necessity have to be taken up before the second track could be laid, and therefore the case is very different from that in which the road is prepared for two tracks in the first instance.

5. The difficulty of forming a new embankment against an old one, (such as would be required in the widening of the road bed,) is not to be overlooked. A writer upon this subject says, "It may be proper to advise that new banks ought not to be placed upon steep ground without considerable care in first forming it into levels, like steps, to prevent the slipping of the new part, as happened near Bradford on the Kennet and Avon canal; after all the care that was taken, great lengths of the canal slid down into the Avon river below."

From the foregoing statements, the conclusions which we arrive at are these:

First, That it appears to us that sound policy would dictate the propriety of grading the road sufficiently wide for two tracks, even upon the supposition that but one is to be laid down. In fact the width usually assumed for two tracks, is scarcely more than is requisite for one, to insure proper drainage, and to clear the road bed of snow.

Second. If it should be deemed expedient by the Board to adhere to the resolution of the 4th October, directing the road to be graded for a single track, we would state the necessity of extending the width of the embankments to 16 feet upon all parts of the road: that upon the 12th and 13th Sections, embracing the summit, and where both cutting and filling are heavier than upon any other portion of the line, the road be graded for two tracks, the cuts to be widened for an opportunity to drain the bed thoroughly,

and the embankments to be extended, for safety. The difference in cost, at the prices agreed upon with the contractors, as is stated in the table above, is \$6945 91, or only about 8 per cent. additional, and this upon a length of road of about 2 miles. The difference in price between a double and single track, being upon these sections 4 cents per yard for earth and loose rock together, and 10 cents for solid rock.

Third. We would respectfully suggest, for your consideration, the propriety of modifying the order of the Board in reference to the width of the track, in such a manner, that your engineers be invested with discretionary authority to alter the width of the cuttings and fillings at such points of the road as may seem to them judicious and proper, according to the circumstances of the case. A single fact will serve to show the necessity of this measure. In many cases the embankment exceeds the excavation; to make up the deficiency, the obvious course would be to widen the cut sufficiently to form the embankment, in preference to borrowing earth elsewhere. This is a single instance, but it will convey an idea of the inexpediency of defining too closely these matters of detail; they are in most instances contingent in their nature, and require to be arranged and suited to each particular case.

We omit all reasoning on this part of the Report, which we think might, with propriety, be based on the eventual responsibilities of your Engineers for whatever strictly pertains to their profession.

Respectfully submitted,

WM. GIBBS McNEILL,
GEORGE W. WHISTLER, .
W. H. SWIFT.

REPORT

ON THE

SURVEYS BETWEEN SEVEN MILE RIVER IN BROOKFIELD,
AND TEKOA MOUNTAIN IN MONTGOMERY.

Worcester, Jan. 15th, 1837.

TO THE PRESIDENT AND DIRECTORS OF THE WESTERN
RAIL ROAD CORPORATION.

GENTLEMEN,

The Reports which were made to the Board on the 15th of August, and 30th of September last, contained a description in detail, of the several routes which were surveyed and approximately located, between the villages of Worcester and East Brookfield, and the order of the Board of the 4th October, confirming the location recommended by the Engineers, in their Reports above referred to, established that portion of the line. It becomes our duty, now, to lay before you a statement of the operations of the Engineer department since the Report of 30th September was adopted by the Board.

Immediately subsequent to that period, the requisite measures were taken for the definitive location of the route between Worcester and East Brookfield, comprising the first division of the road, and on the 19th of October, this portion, embracing an extent of 19.5 miles, was advertised for contract. Proposals were invited until the 20th November, and propositions from a large number of efficient and experienced contractors were received. Upon such of the sections as the proposals appeared to be suitable, and advantageous to the Corporation, decisions were made, and the work was let; while upon others, embracing portions of the work of greatest magnitude, the decisions were deferred, to afford full time to the contractors to acquaint

themselves with the character of the work. About the middle of December the entire division was placed under contract; and about the same time the grading was commenced on the tenth and eleventh sections. Since that period, the work has been commenced on six other sections, and the balance will be in progress in a short time.

The surveys, upon which a Report has been made, terminated, as has been stated, near the Seven mile river, in East Brookfield; and at this point, only, may the line be said to have reached, fairly, the Chickopee valley. We have now to trace its direction, as it has been approximately located, in its course towards the Connecticut river.

From the crossing of the Seven mile river, near Gallup's mills, down to Taft's scythe factory, in the western part of the town of Warren, about eleven miles, the line pursues, without any deviation, the immediate valley of the Chickopee river; crossing it, in this distance, eight times, to avoid abrupt curves, and to take advantage of the best ground. From this factory, two routes were surveyed—one across the peninsula upon which Palmer village is situated—and the other, around by the valley of the river. The distance by the Palmer village line, is nearly two miles shorter than that by the river line; but it will be seen, hereafter, that we cannot pass the Palmer summit. The lines unite again, near Sedgwick's tavern, on the Chickopee river, about 10.4 miles, by the river line, below the scythe factory. At Sedgwick's, the Chickopee bends away to the north, to its junction with the Ware, and Swift rivers, at the village of Three Rivers; while the route continues, by a very direct course across a second peninsula, and through the valley of Baptist brook. At $3\frac{1}{2}$ miles beyond Sedgwick's, the river, after having made its circuit to the north, returns south, and washes the base of the Wilbraham mountain, (so called,) and at this point the route falls upon the stream again, and continues near to it $2\frac{1}{2}$ miles, to the point of Stony hill, also in Wilbraham, and about $7\frac{1}{2}$ miles east of the Connecticut River. At this place, the hill and the river nearly close again, leaving a flat space between them of some 300 or 400 feet.

The point of Stony hill, we have considered to be the termination of the Chickopee river division; that is to say, any, or every route, by the valley of that stream, must

finally pass by, or near this point, and as it is necessary to fix upon some particular spot which shall be common to all the routes extending west, across the Connecticut River, in order that comparative estimates of the cost of grading may be presented, we have decided upon this as the most suitable point.

The above general description will serve to show the main direction of the line between the end of that portion of the Rail Road, which is located and put under contract, and the extremity of the plain, or flat land, which lies on the east side of the Connecticut river. To this it may be well to add a more detailed statement of particular portions of the route. From the Sturbridge road (the end of the first division,) to the point of Cranberry hill, in South Brookfield, the line is straight nearly 3 miles; it crosses the Five mile River 800 feet south of the Furnace village; and thence across a part of the north end of the Great Swamp. Of the 4000 feet of this swamp, which the line passes over, about 2000 feet of the distance is impassable for teams, except in winter. The soundings upon it are from 18 inches to 5 feet, but usually less than 2 feet. Therefore the material, which will be thrown up from the ditches, and the sides of the road, will furnish a considerable portion of the embankment; and the residue can be conveniently obtained from the points of hard land, which form the boundary of the swamp. Turning the point of Cranberry hill, upon a curve of 2865 feet radius, the line is straight to Stone's hill, upwards of a mile. The greater portion of this distance is over an arm of the Brookfield meadows. These meadows, also, are too soft for teams. Roads are made across them, and the bed of the Rail Road can be constructed over them without much additional expense. The soundings are generally from 3 to 4 feet; a few places 9 or 10, and at a very few, 12 feet will not reach the bottom. At Stone's hill, the line curves to the north upon a radius of 5730 feet, and by crossing the river twice to cut off an abrupt bend, it reaches, in $1\frac{1}{2}$ miles of straight line, the county road from West Brookfield to Brimfield; thus from the Seven mile River to the west parish of Brookfield, we have, with the exception of the two moderate curves at Cranberry hill, and Stone's hill, a straight line of $6\frac{1}{2}$ miles; and, inasmuch as the point named first, presents a

very favorable position for a depot where the trains will stop, the line may in fact be considered straight. From the Brimfield road the line curves to the west, upon a radius of a mile; and crossing the Chickopee River, it falls upon the point of Long hill; turning this hill upon a radius of 2865 feet, it continues straight, nearly to "Warren city," $1\frac{1}{2}$ miles.

From the Five Mile River to Warren city, $8\frac{1}{2}$ miles, there is but 5 feet fall in the Chickopee river, or about 0.59 feet per mile; while in the next succeeding $5\frac{1}{2}$ miles, the fall is 212 feet, or 38.50 per mile; thence for $5\frac{1}{2}$ miles, it is 78 feet, or about 14 feet per mile. This will serve to show how unequally the fall in this portion of the stream is distributed, and consequently the character of the grades which must be given to the road.

Passing through the south part of the city, or village, of Warren, upon a curve of 3820 and 2865 feet radius, the line passes under the high hill, south of Moore's mill-pond. From thence to Blair's saw-mill, at the north point of Grattan mountain, the valley of the stream is much contracted, and very crooked. To avoid a constant succession of curves in this, the steepest part of the road, it may be necessary to cross the river eight times, in a distance of about 3 miles, or resort to the expensive alternative of making deep cuts across the bends of the stream. After passing Blair's saw-mill, the river runs due south 4 miles. Upon this portion of the route, lines have been located upon both sides of the stream, and connected with each other at intermediate points. The main line, (as we now consider it,) continues down on the east side of the bend of the river, to a point below Capt. King's, there crossing the stream; it continues on the west side to Fenton's; here the river turns off to the west, and the line pursues the north side of it, to a point $\frac{3}{4}$ of a mile east of Sedgwick's tavern; the river here runs to the north, and the line after crossing it for the last time, passes over a slight summit to the valley of Baptist Brook; from thence it is straight, nearly two miles, to the point of the Wilbraham mountain; turning this point, upon a radius of 2865 feet, the line is again straight, $2\frac{1}{4}$ miles to the point of Stony hill.

As this portion of the route, (from E. Brookfield to Stony-hill,) stands in a manner by itself, there being no other

than the route by Palmer village, which it is necessary to compare with it, we shall state concisely, in this place, the general results furnished by the surveys and computations.

Length of the line from the Sturbridge road (end of 1st Division) to Stony hill	-	-	-	Miles, 27.13
Maximum grade	-	-	-	Feet, 42.48
Estimated cost of grading and bridging, for a single track (20' & 12')	-	-	-	\$546,040.00
Per mile	-	-	-	20,120.00

The curves upon this line are as follows: 6 of 5730 feet radius—16 of 2865 do.—6 of 1910 do. and 1 of 1432.5—the last reducible (probably) to 1671 feet.

The Palmer village line in a distance of 10.32 miles (from the point whence the routes diverge, to that where they unite,) is 1.93 miles shorter than the line by the river. The rise from the scythe factory to Gammell's summit, in Palmer, is 132 feet, and the distance 2.84 miles; thence across the deep valley of Gammell's or King's Brook to Davis's, the descent is 27 feet, and distance 1.14 miles. From Davis's to the Chickopee River, below Sedgwick's, the descent is 340 feet, and the distance 3.44 miles, or about 100 feet per mile. This, of course, is inadmissible. But in addition we may add, that the grading, even upon these inclinations, could not be effected, unless at great cost. We consider, therefore, that the route by the river should be adopted.

We now proceed to the description of the routes across Connecticut River, between Stony hill and Tekoa mountain.

From the western termination, at Stony hill, of the division first described, to Tekoa mountain, (near the line between the towns of Westfield and Montgomery,) a distance of about 20 miles, several routes have been surveyed, and approximately located, with a view to ascertaining the best practicable line between these two points. They embrace an extent of about 5 miles, on the Connecticut River, viz. from the mouth of the Chickopee on the north, to Mill River on the south.

That part of the plain which lies on the east side of the river, and heretofore referred to, is, generally speaking, undulating, with occasional pond holes, and ravines, scattered over its surface; but no considerable ridges, or knolls, are to be found upon it. Its descent towards the river is very gradual, say from 5 to 10 feet per mile. The bed of the

river itself is about 170 feet below the plain, and the bank of the same about 150 feet below. On the west side of the Connecticut, this plain is interrupted by a ridge, which extends south, from the elevated ground near Northampton, and runs nearly parallel with the river, through the whole length of the town of West Springfield. The ridge in this extent is broken at two places only, viz. at Bush's Notch, west of the mouth of the Chickopee river, and at Morley's bridge, a little north of west of the village of Springfield. At the first of these points, it may more properly be called a depression; at the second, the Westfield River cleaves it to its base. It is through these two gaps that all the routes pass, in their course to the west.

The northern line, which we designate the Cabotville route, commences at the point of Stony-hill; and to the Connecticut River, a distance of 7.90 miles, it is virtually straight, there being but two curves of large radius upon it (and one of these, even, might be thrown out) it passes over the plain by easy grades, about $\frac{1}{2}$ mile south of Jenks's or the Ludlow factories, thence north of Dimick's pond, and Five mile pond, and about $\frac{3}{4}$ of a mile south of the Chickopee factories; opposite this point, the descent commences at a grade of 48.50 per mile, crossing the river just below the mouth of the Chickopee, by a bridge 1050 feet in length, the line ascends to Bush's Notch, before referred to. The depression in the ridge at this place is 237 feet above the Bench Mark, at the eastern abutment of the Springfield bridge, and by the line as located, is $3\frac{1}{2}$ miles from the west bank of the river. The ascent is effected at grades of 83.31, 56.57, and 38.48 feet per mile. From the Notch to Tekoa mountain, the route is very direct; the descent to the plain at Sacket's brook, is at grades of 40.33 and 15.36 feet per mile; thence ascending 41.12 per mile, thence descending to the canal feeder at Tekoa 24.84 per mile. The total descent west from the Notch to the feeder at Tekoa is 127 feet.

If the extraordinary height of 50 feet for the bridge at the Connecticut were assumed, the grades would be reduced from 48.50 to 42.50 per mile on the east, and from 83.31 to 74.31 on the west side of the river. In such a case, the cost of grading and bridging would be increased \$28,746.47.

The whole distance from Stony-hill

to Tekoa, by this route is -	Miles	19.32
Maximum grade - - -	Feet	83.31
Estimated cost of grading and bridging	\$	422,060.40
Cost per mile - - - -	\$	21,840.00

The second line is called the End Brook route. It passes straight from Stony-hill to Hog-pen dingle (a small branch of Chickopee river) crossing in its course a part of Dimick pond, and Five mile pond. From the Hog-pen dingle, it curves gently into the ravine of End-Brook, and follows the valley of this stream to Daniel Hitchcock's, descending at a grade of 36.16 and 55.00 feet per mile. From Hitchcock's, two routes across the river were surveyed—the first to unite with the Cabotville line, near Bush's Notch, and the second to unite with the Garden Brook line (hereafter to be described) near Ashley's mill, on the West-field river. The first, or northern branch, leaves the valley of End-Brook, at Hitchcock's, and passes straight across the river, about midway between Cabotville and Springfield, by a bridge 700 feet long, to the ravine of Darby Brook, a small stream which enters the Connecticut, near the West Springfield Meeting-house; following a branch of this stream to its source, at grades of 54.30 and 38.25 feet, it turns north and falls into the ravine of another branch (the same upon which Pliny Bagg resides) thence crossing the heads of Ashley's brook and Block brook, it pursues a N. W. course, until it unites with the Cabotville line, a short distance east of Bush's Notch.

The distance by this route is -	Miles	20.85
Maximum grade - - -	Feet	55.00
Estimate - - - -	\$	386,958.96
Per mile - - - -	\$	18,560.00

The south branch of the End Brook route, being the third line examined, deflects from the north branch, at Hitchcock's, as before stated; and by a curve to the south it continues to descend the valley of End Brook, at a grade of 52.80 feet to the river, opposite the W. Springfield common; crossing the Connecticut at this point by a bridge of 970 feet

long, it pursues a direct course to its junction with the Garden Brook route at Ashley's mill.

The distance by this route is	-	Miles	22.26
Maximum grade	- - -	Feet	52.80
Estimate	- - - - -		\$291,440.97
Per mile	- - - - -		\$13,091.00

The fourth line is the Garden Brook route. This line as approximately located, is straight from Stony hill to the head of Garden Brook ; crossing in its course Loon pond, and the south part of Five mile pond, by introducing two curves of 2 miles radius, as at present proposed, and represented upon the map, a better line would be obtained, that is to say, one of the ponds would be wholly avoided, and the other would be crossed at a very narrow part of it, and where the depth is but 12 to 14 feet, and in addition it would facilitate the entrance of the route into the Garden Brook valley. The distance would be increased by this alteration 300 feet or 0.05 per mile. This line descends from the plain at an uniform grade of 45.07 feet per mile ; passes through the village of Springfield, and crosses the Connecticut by a bridge 1200 feet long at a point between the present bridge and Ferry street ; thence by a curve of a mile radius, it winds into the valley of the Westfield river, and falls upon the stream at Ashley's mills, in the western part of W. Springfield, and unites at that point with the south branch of the End Brook route. From Ashley's mill to Morley's bridge, about 4 miles, the line continues upon the north side of the river, and generally near its margin, ascending at easy grades. From a point, a short distance beyond Morley's bridge, to Tekoa, two distinct routes were surveyed, one on the north, and the other on the south side of the Westfield Great River. Continuing by the north side, it will be necessary to embank to the height of about 8 feet for a distance of a mile, over the Westfield meadows, to guard against the effects of freshets. The greater part of the material required to form the embankment can be thrown up from the sides and ditches. Crossing the Hampshire and Hampden canal by a draw-bridge, the line passes over very favorable ground, until it reaches the canal feeder near Tekoa.

At this place it comes in contact with the feeder, and to provide a passage for both, it will be necessary to cut through the rock which forms the point of Tekoa, or pass the road over the feeder. The line as at present located, is upon the feeder bank, for a distance of 6000 feet. The width of this bank might be increased. But without considerable expense in giving it a proper foundation, by introducing substantial side walls along the river, it would be subject to the same evil which attends the feeder.

The distance by this route is	-	-	Miles	22.02
Maximum grade	-	-	Feet	45.07
Estimate	-	-		\$308,215.50
Per mile	-	-		\$14,000.00

The sixth route is the Mill-River route. This line was surveyed and located, under the direction of Mr. Fessenden, in 1835. The estimate of the cost of grading this line, has been made up in the same manner that the estimates of the other lines have been made, (the grades themselves are Mr. Fessenden's). In order to connect it with our lines, it has been carried from the point at which it terminated near State street, to the river at the present crossing place of the Garden Brook line, between the bridge and Ferry Street.

From the point of Stony hill, the Mill River line, like the others, is straight, in its course over the plain; after falling upon the river near Scott's house, it pursues the valley, with frequent crossings of the stream, to avoid abrupt curvature, and descending at grades of 43, 16, 5, 21, and 42 ft. per mile, it turns the point of the high bank, near Mill Street, and from thence to its termination at State Street, it follows the same bank, nearly parallel to the Connecticut River; from State Street, it was connected with the Garden Brook line, in the manner referred to above.

The distance by this route is	-	-	Miles	22.68
Maximum grade	-	-	Feet	43.30
Estimate	-	-		\$319,531.61
Per mile	-	-		\$14,089.00

Route.	Length Miles.	Max. Grade. Feet.	Cost of gra. and bridging per mile.	Total cost of grading and bridging per mi.
Cabotville Route,	19.32	83.81	21840 00	429600.40
End Brook, (Bush's Notch,)	20.85	55.00	18580 00	386858.96
" (Ashley's Mill,)	22.26	52.80	18001 00	391440.77
Garden Brook, (N. side Westfield River,)	23.02	45.07	14000 00	306215.50
" (S. side ")	32.20	45 07	15065 00	344438.89
Mill River Route.	23.68	48.30	14089 00	319831.61

The above estimates are for the track adopted by the Board, for the 1st Division, viz. 20 feet in the cuts, and 12 feet at the surface of the embankments.

We shall in the comparisons reduce the number of routes to four, by taking the main, or north branch of the Garden Brook line, and the south, or Ashley's Mill branch of the End Brook line; these branches being less in their cost than the branches by Bush's Notch, and the South side of Westfield river. We have then to consider the Cabotville route; End Brook route; Garden Brook route; and the Mill River route; and may thus recapitulate the advantages, and disadvantages of each.

1. *The Cabotville line.*

Its advantages are that it is the straightest, and consequently shortest, of all the routes, viz. 2.94 miles shorter than the End Brook—2.70 shorter than the Garden Brook, and 3.36 shorter than that by Mill River. It passes near the Ludlow Factories, near the Chickopee Factories, and through the village of Cabotville. Its disadvantages are that it has steeper grades than either of the other routes, that it has two summits between the Connecticut river, and Tekoa mountain, requiring three descending grades to the West, amounting to 127 feet, and that the cost of grading it, will be greater than upon either of the other routes.

2. The End Brook route by Ashley's Mill.

Its advantages are, that it passes through the village of West Springfield and Westfield—it crosses the river by a bridge 230 feet shorter, than that by either of the other

routes—the cost of grading is also less. Its disadvantages are, that it has steeper grades than any except the Cabotville, is more crooked from the plain to the river, than either of the others, and passes about midway between Cabotville and Springfield, avoiding both places.

3. *The Garden Brook route.*

In point of directness is second only to the Cabotville line; and with the exception of the Mill River line (which in its maximum grade is 1.77 less steep) has easier grades than the others; passes through the villages of Springfield, West Springfield, and Westfield; and with the exception of the End Brook route, can be graded for less than either of the others.

4. *The Mill River route.*

The grades of this line are better than either of the others, not only in having its greatest inclination less than that of the others, but in the general descent towards the river from the plain. Mill River being much longer than either Garden Brook, or End Brook, presents by its valley, greater facility in descending. It also passes through the three Villages enumerated in the Garden Brook line. Its disadvantages are, that it requires frequent bridging over the Mill River—is the most crooked—passes through very valuable property in nearly the whole of its extent through the village of Springfield—the cost of grading and bridging is greater than upon any except the Cabotville line; and the land damages upon that part of the line which lies within the thickly settled part of the village of Springfield, of upwards of $1\frac{1}{2}$ miles in extent, would be excessive.

From the foregoing statements, the relative merits of the several routes may be understood. In the End Brook route, notwithstanding the cost of grading may be \$16,000 less than the Garden Brook route; yet we consider that its steeper grades, increased curvature, and its remoteness from the two business points on the river, (Cabotville and Springfield,) more than counterbalance the advantage which it possesses in respect of cost. The Mill River line

we conceive to be less favorable in its character, than the Garden Brook route, from its greater length, greater curvature, and greater cost. There remains then the Cabotville line, and the Garden Brook line, to compete for the preference.

Equating the Cabotville line at 19 feet per mile, (this being about the slope which requires double the power that is required upon a level,) we find that the 127 feet which this line descends from Bush's Notch towards Tekoa, is equal to 6.70 miles of level road; and upon the Garden Brook line, equating in the same manner, for the descent of 10 feet given to the line at the Pawcatuck valley, to reduce the embankment, we have 0.53 miles as the equivalent. The two routes, therefore, in respect of length, grades, and cost, stand thus :

Routes.	Actual distance in miles.	Equated distance Miles.	Max. grade. Feet.	Cost of grading and bridging.
Cabotville route	19.32	26.02	83.31	\$422,060 40
Garden Brook route	22.02	22.55	45.07	308,215 50
Difference	2.70	3.47	38.24	113,844 90

Thus it will be seen, that while the actual distance by the Cabotville line is 2.70 miles less than by the Garden Brook line, the equated distance, which is the measure of the cost of transportation, (and is perpetual,) is 3.47 miles more. The effect of this is, that the cost of transportation would be $15\frac{1}{2}$ per cent. greater upon the Cabotville line, than upon the Garden Brook line. Again, the tolls being measured, not by the equated, but by the actual distance, the receipts from the two routes would be in the ratio of their lengths, or as 22.02 : 19.32, in favor of the Garden Brook route; in other words, the receipts upon the Garden Brook line would be 14 per cent. greater than by the Cabotville line.

From the results thus obtained, we find, that, in the Garden Brook line, the cost of grading will be less than that of the Cabotville line—that the cost of transportation will be less, and that the grades will be less. We do not hesitate, therefore, to award it the preference; and we respectfully recommend that it be adopted.

The following Maps, Tables, and Profiles accompany this Report. They embrace all information in detail, appertaining to the routes, which can be required in forming an opinion upon their comparative merits.

Table A, contains a synopsis of all the routes, from Stony hill to Tekoa mountain, exhibiting the length, ascents, descents, elevation, grade, excavation, embankments, bridges, culverts, and estimated cost of grading and bridging upon each stage of the several routes.

Table B contains the length and cost of various parts of routes not embraced in the synopsis.

Table C contains the radius of curvature, and aggregate length of curves of each route.

MAPS AND PROFILES.

- No. 1. Map of approximate location from East Brookfield to Stony hill, and to the head of Garden Brook ; also of the line by Palmer village. The whole on a scale of 1000 feet to an inch, or 5.28 inches to a mile.
2. Profiles of the same, with those of attempted improvements.
3. General Map of the country between Stony hill and Tekoa mountain, embracing all the routes which have been surveyed, and approximately located, between those two points. Also on a scale of 1000 feet to an inch.
4. Profile of the approximate location of the Cabotville line from Stony hill to Tekoa.
5. Profiles of the End Brook line from Stony hill, to its intersection with the Garden Brook line at Ashley's mill.
6. Profiles of the End Brook line from Hitchcock's by Darby Brook, to the Cabotville line, east of Bush's Notch.
7. Profile of the Garden Brook line from Stony hill to Tekoa by the north side of Westfield river.
8. Profile of the same, by the south side of the Westfield river, through the village of Westfield, to its junction with the main line, on the north side of the river, west of Tekoa.
9. Profile of the Mill River line.

The surveys and approximate locations of these several

lines, were made by Mr. Stebbins, Mr. Childe, and Mr. Barton, with their assistants, Mr. Werner, Mr. Gillespie, and Mr. Irving.

Surveys have also been extended by two distinct routes to the New York state line at West Stockbridge. That by the valley of the Great Westfield River, Washington, and Pittsfield, &c. we designate the North Route. That by the valley of the Little Westfield River, Granville, Otis, &c. we designate the South Route.

Upon the North Route, the line has been surveyed, and approximately located, entirely through to the New York boundary. From Tekoa mountain it passes through the towns of Russell, Chester, Middlefield, Becket, Washington, Hinsdale, Dalton, Pittsfield, Richmond, and the north-west corner of West Stockbridge.

The surveys, and approximate location of the route from Tekoa mountain to Pittsfield, were made by Mr. Childe, with the occasional assistance of Mr. Barnes, Mr. Irving, Mr. Gillespie, and Mr. Foot, as levellers. From Pittsfield to the New-York line, the approximate location was made by Mr. Potter, and his assistant, Mr. Bartlett.

An attempt was made at several points to ascend the valley of Walker Brook, in Chester and Becket, by an inclined plane, with a view to connect the North and South routes, near Green Water Pond in Becket; and thus avoid the great bend which the river route makes through Hinsdale, and Dalton. But after various unsuccessful efforts, the project was abandoned, the spurs of the mountain being found to be too numerous and formidable. These surveys were made by Mr. Barton, and his assistant, Mr. Irving.

Upon the South route several experimental lines have been surveyed, to wit:

1. A route branching from the Garden Brook line at Oakley's, two miles east of Westfield village, and by the valley of the Little Westfield river. South branch of do. or Peeble's brook, and Beech hill, to the summit, near the line between Otis and Blandford. This line passes through Westfield, the South East corner of Russell, Granville, Blandford, and North East corner of Tolland. The summit is in a Spruce swamp, near the Blandford line, and one mile east of East Otis village.

2. A route from Hodges', at the foot of the mountain near the Westfield and Russell line, by the north side of the Little Westfield river, and north branch of the same, to Lyon's summit, in Otis, $3\frac{1}{2}$ miles North West of the Spruce swamp, in Granville. This line passes through Russell, Blandford, and Otis.

3. A line branching from route No. 1, at the forks of the Little Westfield river, and through the valley of the north branch, nearly parallel with No. 2, to Lyon's summit, in Otis.

4. A line from the Garden Brook line at Oakley's, 2 miles east of Westfield, entirely south of the Little Westfield river, and across Poverty plain, to the foot of the mountain at Agar Noble's. Abandoned as impracticable.

5. A route from Westfield village, by the Powder mill, or the Little Westfield river, thence by the valley of Munn's Brook, and a branch of the same at Lovemonte's notch, around the south point of Sodom mountain, thence to Farnsworth's, Mount Pisgah, Reuben Noble's, and Flat lot, to the Cobble mountain, near Stowe's in Granville, thence turning south, until it reaches within $\frac{1}{4}$ of a mile of the forks of Little Westfield river, at Rowland Noble's in the South East corner of Blandford, thence through the North West part of Granville, and North East corner of Tolland, to the Spruce swamp summit, upon Route No. 1. This line passes through Westfield, Southwick, Granville, Tolland, and Blandford.

6. A route from the mouth of Munn's brook, in Westfield, near the Powder house before referred to, by an inclined plane to Mount Pisgah, north west of Agar Noble's, thence S. S. West to Farnsworth's, and intersecting Route No. 5, at Reuben Noble's, and from thence by it to the Spruce Swamp summit. This line is within the towns of Westfield and Blandford.

7. A route attempting to ascend the mountain at Agar Noble's, by following the valley of Munn's brook, on the east side, from the Powder house, $3\frac{1}{2}$ miles south; thence crossing the brook, and continuing the ascent north, on the west side of the same, and on the eastern slope of Sodom mountain. Abandoned as impracticable.

8. A line from Senate's house, on the route by north

branch of Little Westfield river, across to the South route, at the Spruce swamp summit.

This completes the list of the routes surveyed on the east side of the summit. From the summit west to the New-York line, they are as follows :

9. Continuing Route No. 5, it descends from the Spruce swamp summit, until it reaches the valley of the Farmington river, $\frac{1}{2}$ mile east of Centre Otis ; thence by a very direct course, and easy grades, across the dividing ridge between the Farmington river, and the Housatonic, to Green Water pond, in the western part of Becket, thence descending by the valley of Green Water pond brook, chiefly on its north side, to its junction with Goose pond brook, in Lee, $\frac{1}{2}$ mile east of the Housatonic river, thence by the valley of the Housatonic, crossing Hop brook valley at M'Allister's, and through South Lee to Stockbridge. From thence the line continues through the village of Stockbridge, and across the bend of the river at Phillips's, thence by the south side of Mohawk pond, to the summit between the Housatonic and Williams' River, at Fueri's house, thence north west, by the valley of Williams' River, to the Hudson and West Stockbridge Rail Road depot, in the village of West Stockbridge, and from thence by the route of said road, $2\frac{3}{4}$ miles to the termination of the Hudson and Berkshire Rail Road, at the New York state line, and at this point it unites with the North route through Pittsfield, &c. The western portion of Route No. 9 (from the Spruce swamp) passes through Otis, Becket, Lee, Stockbridge, and West Stockbridge. A branch of this line passing farther north leaves the main line east of Stockbridge village and crosses the dividing ridge between the Housatonic and Williams' River at the toll gate. On the Albany road (Curtis's) it unites again with the main line at the proposed depot of the West Stockbridge Rail Road in West Stockbridge village.

10. Returning to Route No. 5, in the North West part of Granville, a line was run through Tolland by Noyes's pond, to a summit at Coles's, about 6 miles south of the Spruce swamp summit, and 47 feet below it, thence turning north, and falling into the valley of the Farmington, near the North West corner of Tolland, thence pursuing this valley to the North East corner of Sandisfield, and there

abandoned, as the crossing of the Farmington valley was considered to be impracticable. Another line nearly parallel to this, but passing farther east, was attempted from Coles's summit. It passes by Messenger pond in Tolland, the south side of Cotton's pond in Otis, and intersects the western branch of this Route (No. 10,) near the outlet of Larkin pond in the South West corner of Otis.

11. From the point last mentioned, (outlet of Larkin pond) a line was carried across the Farmington River, through the Beech plain, and by the outlet of Spectacle pond, both in the north east part of Sandisfield, thence through the village of West Otis, to the head of Hop Brook, a branch of the Housatonic, and thence by the valley of that stream, and north of the Shaker village, to its junction with No. 9, by Green water pond, at M'Allister's, near the mouth of Hop Brook. This line passes through the north east part of Sandisfield, and the whole length of Tyringham.

12. From Green Water pond, a line was run on the south side of Green Water pond brook, and crossing Goose pond brook, about $\frac{3}{4}$ of a mile south east of Sturgis's tavern, thence winding round the slope of East mountain, into the valley of Hop brook, thence ascending this valley to a point opposite the Shaker village, in Tyringham, (referred to in the description of the last route,) for the purpose of getting a suitable place to cross Hop Brook, thence turning west, it unites with route No. 11, north of the Shaker village.

13. Leaving the Green Water pond Route, (No. 5,) about $2\frac{1}{2}$ miles below the pond, between Barrett's and Shelden's, a line was traced on the side of the mountain, which forms the eastern boundary of the Housatonic valley, up to the Furnace in the north east corner of Lenox, crossing the Housatonic river at this place, it passes by the south side of Scott's pond, into Lee again, thence into the north part of Stockbridge, thence turning the north point of Rattle Snake mountain, it passes south of Great pond, and north of the village of Curtisville, and unites with the north branch of Route No. 9, at the toll-gate summit (Curtis's) on the Albany turnpike.

These routes were surveyed, chiefly, by Mr. Morgan, with the assistance of Mr. Barton, and Mr. Williams;

From the extent of country which it was necessary to examine, the surveys have been entirely experimental; and no one line has been approximately located. But from the facts collected, we have now the means of pointing out the best practicable line for approximate location, whenever it shall be judged expedient to make the same.

Respectfully submitted, by,

Gentlemen,

Your obedient servants,

WM. GIBBS McNEILL,
GEORGE W. WHISTLER,
W. H. SWIFT.

SYNOPSIS OF ROUTES FROM STONY HILL TO TEKOA MOUNTAIN.

Stations.	Length.		Total Length, Miles.	Ascent of Grade.		Total Descent, Feet.	Total Descent, Feet.	Elev. of Ground at Bench, on C.R. B.	Excavation, Cubic yards.		Embank- ment, Cub. Yds.	Bridge, Length Feet.	Abut- ments & Piers.	Cul- verts.	Grub- bing- Feet.	Amount.
	Feet.	Miles.		Feet.	Feet.				Earth.	Rock.						
Bench at Stony Hill.																
3565								1775								
to 2630	6500	1.231	1.231	9.5	9.5	185	185	7.717	73488.94		15437.83				300	16203.56
2630	5000	0.946	2.178	18	27.5	150	162.5	19.027	40402.14		40728.95				200	8984.36
2750	7000	1.323	3.503	5	32.5	150	154.5	4.553	26306.40		17863.39				1500	6061.34
2808	5900	1.098	4.602	140	172.5	5	151	45.074	8055.51		12553.10					2891.56
110	16400	3.106	7.708	5	177.5	00	145	5.285	49053.54		54984.98	160	30.00		8900	104179.14
160	5000	0.946	8.655	70			70	72.5	74431.23	4270.65	20973.95	1250*	5024.65		50950.81	
324	13400	2.537	11.192	10			00	Level.	68156.65		35014.42				4400	22373.00
330	2600	0.492	11.584	8			60	50	518.53		39.35				1600	15290.84
360	4000	0.859	12.443	78			68	74	63050.05	5654.96	28542.03					2482.65
484	12400	2.353	14.796	18			86	69	487.94		35925.79	30	564.30		20778.30	
548	6400	1.207	16.003	72			86	93	1847.97		43936.29	30	109.29		11778.88	
596	4800	0.909	16.912	7			93	110	59779.66		18948.97				2821.25	
670	7400	1.401	18.313	72			165	163	15248.27		33468.31				13398.56	
784	11400	2.169	20.472	5			170	167	5.285	875.60	52538.60				12229.53	
834	5000	0.946	21.418	10.5			180.5	197	22923.47		22603.45	50	624.00		10746.91	
865	3100	.587	22.005						16915.78		14302.80		270.46		7206.51	
Total.			22.016						892126.08	12078.11	447462.21	1520	6622.70	2625.94	16900	308215.50
3d G. from 2898 to 2824	1600	0.303	4.905				145	151	3966.69		559.47					
2824 to 110				140	172.5	5	20	51.269	278609.58		44330.72	160	30	292.745	8900	70592.10
Childs's L.	14800	2.503	7.708								44920.19	160	30	292.745	8900	70592.10
Total 2d Grade.									262575.27							

No. 1. Route by Garden Brook.

REMARKS.—Average haul on Garden Brook Line, 750 feet.
River Bridge. † Below Bench.
Canal Feeder Bridge. Total, admitting 2d Grades, from 2808 to 110=274425.46. Difference of cost between 1st and 2d Grades, from 2808 to 110=33792.04.
Station 2803 of Stabbin's Line. * Surface of water in Con. River.
Fond Brook Bridge. † Surface of water in Canal Feeder. † Aqueduct for Canal Feeder.

SYNOPSIS OF ROUTES—(Continued.)

Sta. Total.	Length.		Total Ascend. Grade Feet.	De- scend. Grade Feet.	Total ascend. Grade Feet.	Elev. of Elev. of Gr. ab. ground Bench ab. Con. R. on C.R. Con. R. mile.	Excavation.		Embank- ment. Cubic yds.	Bridge length Feet.	Abutments and Piers.		Cut- verts.	Grub- bing.	Amount.	REMARKS.
	Feet.	Miles.	Feet.	Feet.	Feet.	Bridge.	Earth.	Rock.			Perches.	Perches.				

No. 2. Route by Cabotville.

Bench at Stony Hill.										Ar. haul on Cab. 1.860 ft.									
										*Below bench.									
										The canal									
										G. lines will									
										Sur. of water in									
										C. Riv.									
										47, incl. the									
										dit. of cost in									
										et.									
										bridge, &c.									

No. 3. Route by End Brook to Ashley's Mill.

Bench at Stony Hill.																		
0 to 88	8800	1.666	1.666	4.5	4.5	183.	195.							64.80	1700	18730	70	Average haul on End
189	10100	1.913	3.579	29.	33.5	178.	178.	2.700	83623.19	43378.58				126.36	4500	17873	32	Brook Line, 900 ft.
277	8800	1.667	5.248	11.	11.	149.	149.	15.160	34490.79	7778.47				78.21	2800	13409	50	
350	7300	1.382	6.628	50.	83.5	160.	168.	6.600	58714.00	38007.55				233.28	1300	28364	39	
450	10000	1.894	8.522	100.	133.5	110.	133.	36.164	26099.17	50403.64				394.55	1000	58973	59	Below Bench.
464	1400	0.294	9.856			133.	133.	52.800	89011.83	250293.15				32.40		3070	48	Connecticut River.
509	4400	0.765	9.621	15.	26.	25.	25.	Level.		3315.73	950	4509.		39.40		3168	70	
Total.			9.621					18,000	139.33	14108.65				989.80	11300	175589	64	
									385078.36	477932.77	980	4509.						

SYNOPSIS OF ROUTES—(Continued.)

Stations.	Length.		Total length.	Ascend of Grade.		Desc. of Grade.	Total De- scend.	Elev. of G. ab. B'n on C. R. at Bridge.	Elev. of B'n on ab. B. C. R. at Bridge.	Grade. Per Mile.	Excavation.		Embank- ment. Cubic yds.	Bridge length Feet.	Abutments and Piers. Perches.	Cut- verts. Feet.	Grub- bing. Feet.	Amount.	Remarks.
	Feet.	Miles.		Earth.	Rock.						Loose R.								
No. 4. Route by Westfield Village.																			
445.26 of G. Brook Line						4.50		64.00	77.00			490.73		9714.65				2040.07	
to 480	2900	0.549	0.549	5.50				60.00	74.00	8.800				12707.81	180	1285.564		10485.33	Bridge over L. Westfield River.
531	5100	0.966	1.515	5.50	5.50			65.50	63.00	5.176	3923.68			12707.81	180	1285.564		10485.33	Canal Bridge belongs, and is
648	11700	2.216	3.731	29.00	34.50			94.00	92.00	13.087	13499.92			24830.75	140	3896.64	911.25	10394.67	estimated in 3d grade.
680	3200	0.606	4.337					94.00	52.00	Level.	25903.79			10708.20	30	109.29		5440.84	
750	7000	1.326	5.663	8.50	43.00			102.00	95.00	6.041	7439.84			39184.46			128.27	5743.41	Bridge over Westfield River
(875)*	13100	2.462	8.125	63.00	111.00			162.00	195.00	27.269	12077.48		3546.60	700	9808.9389	526.50	3300	71913.36	320 ft. of it instead of embank- ment over Canal Feeder.
881														50	174.000				
Total.	43000		8.125								172100.44			182243.51		11767.45	2720.45	106017.03	

No. 5. From End Brook to Bush's Notch.

398 of End Brook Line.							55.00	50.00									
48	4800	0.909	0.909		50.00		5.00	6.00	55.005	1949.98	925444.78			126.96		9271.71	Average haul on this line 900 feet.
218	17000	3.220	4.129	175.00	175.00		180.00	167.00	54.348	277519.43	52680.43	700	5484	336.21		101871.09	
257	6900	1.307	5.436	50.00	225.00		230.00	236.00	35.255	19920.85	252027.5			510.56		45263.37	Joins Mr. Barton's Cabotville Line at 604 Station.
Total.									398690.91	252027.5	396305.81		5484	973.73	3300	156106.17	

No. 6. Route by Mill River to Springfield.

Bench at Stony hill.							177.50	202.50									
20	2000	0.378	0.378		6		171.50	157.50	10.800	16176.37	5481.68					5014.67	Average haul on this Line, 1000 feet.
71	5100	0.965	1.343				171.50	188.50	Level.	15462.35	9815.87			114.82		5022.96	
134	6300	1.193	2.536		33		144.50	129.00	22.638	15730.34	7581.98	20	534.60	24.50	5000	7398.10	
177	4300	0.814	3.350				144.50	145.50	Level.	11522.19	27538.00	30	1791.44	49.74	3100	14682.58	
216	3900	0.738	4.088		32		112.50	114.50	43.300	14642.46	19184.42			123.68	1800	6410.53	
240	2450	0.464	4.552		7.50	72.50	105.00	104.50	16.183	12741.67	23840.48	30	757.94			10084.54	
271	3100	0.587	5.139		2.50	75.00	102.50	97.50	4.258	55525.81	34829.26	60	2162.16			24540.31	
333	5150	0.976	6.115		20.00	95	82.50	88.50	21.100	57087.36	67505.49	170	1184.43	19.80	1000	23959.97	
406	8300	1.572	7.687		66	161	16.50	10.00	41.980	57418.21	152037.74			336.26		47804.21	
440	3400	0.643	8.330		9	170	7.50	2.50	13.200	160.00	14894.72					4648.36	
Total.	44000		8.330						256480.76		332807.64		6430.57	668.30	9900	149566.87	

Average haul on Village Line, 550 feet. * This 875 new series by Westfield Village, or 862½ same series by the north side of the River.

B LENGTH AND ESTIMATED COST OF PARTS OF ROUTES.

DESIGNATION.	TERMINI.	Length, Miles.	Amount of each part.	Am't of parts forming a continuous Route.	Am. of each continuous Route thus formed.	Total length of each Route.	REMARKS.
Garden Brook Route.	From Stony hill to Sta. 445½.	14.071	248416.71	248416.21	354433.89	22.196	
do. do. by Westfield VIL.	From Sta. 445½ to west end.	8.125	116017.58	116017.68			
End Brook Route.	From Stony hill to Sta. 198½ of Garden Brook Route.	9.631	175584.34	175584.64	391440.77	22.257	
Garden Brook Route.	From Sta. 198½ to west end by north side of Westfield Riv.	12.636	115851.13	115851.13			
End Brook Route.	From Stony hill to Sta. 198½ of Garden Brook Route.	9.631	175584.64	175584.64			
Garden Brook Route.	From Sta. 198½ 445½.	4.686	56051.34	56051.84	337659.16	22.442	
Westfield Village Route.	From 445½ to west end.	8.125	108017.38	108017.68			
Mill River Route.	From Stony hill to Sta. 108 Garden Brook Route.	8.330	149566.07	149566.07			
Garden Brook Route.	From 108 to west end, north side of Westfield River.	14.349	169865.54	169865.54	319551.61	22.679	
Mill River Route.	From Stony hill to 108 Garden Brook Route.	8.330	149566.07	149566.07			
Garden Brook Route.	From 108 to 445½.	6.923	110167.25	110167.25	365751.00	22.688	
Westfield Village Route.	From 445½ of Garden Brook Route to west end.	8.125	106017.68	106017.68			
End Brook Route.	From Stony hill to Sta. 398.	7.538	96619.52	96619.52			
Cross Route to Bush's Notch.	From 398 End Brook Route to 604 Cabotville Route.	5.436	156406.17	156406.17			
Cabotville Route.	From Sta. 604 to west end.	7.877	133933.27	133933.27	386958.96	20.851	
Garden Brook Route.	From Stony hill to east bank of Con. River.	7.630	138249.96				
do. do.	From east bank of Con. River to west end.	14.346	69965.54				
Cabotville Route.	From Stony hill to east bank of Con. River.	7.872	79319.65				
do. do.	From east bank of Con. River to west end.	11.444	310693.59				
End Brook Route.	From east bank of Con. River to west end.	8.589	143360.50				
Garden Brook Route.	From Stony hill to east bank of Con. River.	9.390	192364.37				
Cost of Bridge on Garden Brook Route across Con. River.	From Stony hill to Sta. 198½, end of End Brook Route.		46292.00				Admitting the same grades on this, as on End Brook Route to same point, estim. cost will be reduced at least \$30,000.—E. B. R. is .341 of a mile longest.
Cost of B. on Cab. R. across C. R., (50 ft. above surf. of water.)			60793.63				
Cost of Bridge on End Brook Route, across Con. River.			37841.50				

RECAPITULATION.

NUMBER OF ROUTE.	Rad. 1146	Rad. 1422½	Rad. 1637.1	Rad. 1910	Rad. 2292	Rad. 2666	Rad. 3020	Rad. 3730	Rad. 7640	Rad. 11460	Rad. 3268
No. 1. By Garden Brook.	3800	6000	1875	1450	5450	8250	2450	12200	"	"	"
No. 2. By Cabotville.	1375	1300	"	2900	1600	7200	4100	5500	1200	4000	"
No. 3. { By End Br to 198. 86 of G. B. Line.	"	900	1000	1400	"	4600	2600	3700	"	"	"
No. 4. { From 445½ G. Br. Line by West. vil.	"		1325	1900	"	3125	1850	15600	"	"	"
No. 5. { From 398 or 26 of E. Br. Line to Bush's Notch.	"		3200	"	"	3700	2400	1150	"	"	"
No. 6. { To Springfield by Mill River.	"	2300		"	"	"	"	7200	"	5150	2000

R E P O R T
UPON THE
RECONNOISSANCE AROUND THE NORTH END OF
MOUNT TOM.

Worcester, March 16th, 1837.

**TO THE PRESIDENT AND DIRECTORS OF THE WESTERN
RAIL ROAD CORPORATION.**

GENTLEMEN,

I have the honor to state, that in obedience to the Resolution of the Board of the 21st January, directing the Engineers "to take a view of the route around the north end of Mount Tom," an examination has been made, commencing at a point at which it is probable the route would diverge from the present line, and terminating at the point farthest west, at which it is supposed it can reunite. These two points are the Wilbraham mountain (or Twelve Mile Brook) and Tekoa mountain in Montgomery.

From the Wilbraham mountain, or from Twelve Mile Brook (10 miles east of Connecticut River) the country in the direction of Mount Tom is generally similar in character to that between the Wilbraham mountain and Springfield village—it is in fact a continuation of the same sand plain, with the exception that it is rather more broken in appearance—hence it may easily be conceived that no serious obstacle would be encountered by the Rail Road in its passage across to the Connecticut River, in the direction referred to.

Having reached the valley of the river, by means to be suggested hereafter, the route would cross the stream in the vicinity of the Rock Ferry, at the north end of Mount Tom, thence by the base of this mountain, it would, at the distance of less than two miles, fall into the valley of Manhan

Creek, a stream which flows through the north west corner of the town of Westfield, and enters the Connecticut near the line between Easthampton and Northampton, and a short distance above Mount Tom. Pursuing this valley in a south west direction through Easthampton, Southampton, and the corner of Westfield, it would curve to the west and enter the valley of the Westfield River at Tekoa mountain, the point at which the Cabotville and Springfield lines now unite—

Such probably would be the best general direction for the route indicated in the resolution of the Board; from the character of the country east of the Wilbraham mountain, it is not to be expected that any feasible line could be found *farther* east than Twelve Mile Brook. For the same reason there is no probability that the line can be carried west of Tekoa, previous to uniting it with the Westfield river route. We may therefore fix upon these two points as the beginning and the termination of the route by Mount Tom.

The details of the route may be briefly stated thus: The line after leaving the Twelve Mile Brook, would cross the Chickopee River into the town of Ludlow, and from thence towards Deacon Dutton's, thence about 1 mile south west of Ludlow meeting house and $2\frac{1}{2}$ miles north of Jenks', or the Ludlow factories, thence crossing the small stream upon which the Continental saw-mill is situated, it would follow the plain at the base of the elevated ground in the western part of Ludlow near John Moody's, thence over very favorable ground through the north east corner of the town of Springfield, through the south west part of Granby, and thence into the town of South Hadley.

After reaching South Hadley, the question arises, whether the descent to the Connecticut River can best be effected by falling into the valley of Stony Brook, (called Muddy Brook upon the map,) upon which South Hadley village is situated, or whether it would be better to descend by the river bank some distance south of the village; or again, as Stony Brook, near its mouth, is crooked, whether it would not be better to pass over into the valley of Batcheller's Brook, a small stream which enters the river a short distance above Stony Brook; either of these routes seem to be practicable, but surveys alone could furnish the necessary data for determining which would be the preferable course. The

river at the Rock Ferry is narrow, probably not more than two-thirds the width it has at Springfield village: the approach to the crossing place being from the south, it might necessitate at this point rather an abrupt curve; but that, of course, would constitute one of the considerations which would govern in selecting the route from the high ground to the river. From the west bank of the river, the route would pass over favorable ground around the north end of Mount Tom, and in a distance of less than 2 miles, would fall into the valley of Manhan Creek, between 3 and 4 miles south of Northampton village. Four miles from the Rock Ferry, the route would pass the village of Easthampton, pursuing the general direction of the Hampshire and Hampden canal, which is located through the valley of the Manhan. From Easthampton to Southampton, 4 miles, the line would still pursue this valley, and continue in it to the Westfield boundary line, about $2\frac{1}{2}$ or 3 miles, thence leaving the Manhan, it would wind around the point of high ground which is connected with Tekoa, following the direction of the canal feeder from the Westfield River, and finally unite with the present route, as has been stated, at the junction of the Cabotville and Springfield lines at Tekoa Mountain.

TABLE OF DISTANCES BY MOUNT TOM.

	Miles.
Twelve Mile Brook to Deacon Dutton's,	- - - 3
South Hadley,	- - - 9
Rock Ferry,	- - - 2
East Hampton,	- - - 4
South Hampton,	- - - 4
Tekoa Mountain,	- - - 7
Total,	29

TABLE OF DISTANCES BY SPRINGFIELD VILLAGE.

	Miles.
Twelve Mile Brook to Stony Hill,	- - - 2
Tekoa Mountain,	- - - 21
Total,	23

The distances given in the above Table, by Mount Tom, were not measured, but are, as far as Southampton, (22

miles from Twelve Mile Brook,) believed to be nearly correct, as they were corroborated by different individuals along the line. The distance from Southampton to Tekoa is not stated with the same degree of confidence; it was taken from the town map.

It was not deemed necessary to make any examinations for a route between the Cabotville line and that just described, for it would evidently be longer; the only object in such a case would be to comply with the terms of the charter, requiring the road to cross the Connecticut River in the town of Springfield.

Respectfully submitted,

W. H. SWIFT, RESIDENT ENGINEER.

REPORT

UPON THE

SURVEYS BETWEEN CONNECTICUT RIVER AND THE
WESTERN BOUNDARY OF THE STATE.

Springfield, June 12th, 1837.

TO THE PRESIDENT AND DIRECTORS OF THE WESTERN
RAIL ROAD CORPORATION.

GENTLEMEN,

In pursuance of the order of the Board, of 21st January last, the line from the point of termination of the First Division in East Brookfield, to Stony hill in Wilbraham, has been located. With the exception of such improvements, at particular portions of the line, as might be anticipated from a thorough revision of the whole, it corresponds, generally, in its essential points, with the route approximately located, and described in the Report to the Board of the 15th January last, and in lieu of recapitulating the details of the route, we would refer to the above mentioned report, and to the accompanying Maps and Profiles, for such information, in reference to the same, as may be desired. There are two points, however, upon the route, at which the line is not definitively located, and as the selection will depend, ultimately, upon the results to be furnished by surveys now in progress, the question cannot, at this time, be determined. One of the points referred to, is at the Brookfield meadows, and the other is in the vicinity of Warren village. The modifications are proposed, with a view to the saving of expense in the cost of construction. In the former case, the line in its present situation, fulfills the condition required for a perfect road, being for a distance of 2 miles, both straight and level. But the question arising in our minds, whether it would be attainable within

reasonable limits, compared with the cost of constructing the line which we propose to substitute for it, we were unwilling, without the fullest investigation, to incur an expense which the circumstances of the case might not justify, and without all the facts, it would be premature to attempt to decide correctly upon it.

By the order of the Board of 22d of March, that portion of the line between Stony hill in Wilbraham and Armory Street in Springfield, was ordered to be located, and from Armory street to a point on the west side of Connecticut river, lines were directed to be approximately located, on both sides of the Garden brook. In accordance with these instructions, the duties enjoined therein have been performed, a very favorable location has been made across the plain from Stony hill to the head of Garden brook; and from thence to a point one mile west of Connecticut river, four distinct lines have been approximately located. These lines cross the river between the present bridge and Ferry Street, embracing an extent north and south, of about 1600 feet. They are about three miles in length, and so similar in character, that it will be necessary to describe them rather minutely, to enable the Board to judge of their respective merits. For the sake of perspicuity we number these several lines, 1, 2, 3, and 4.

No. 1. Commencing in the valley of Garden brook, at a point 3000 feet east of Armory Street, the southern line deflects to the south 2° in a distance of 400 feet upon a curve of 2 miles radius; thence by a tangent of 200 feet, thence it deflects to the north 15° in a distance of 3000 feet upon a curve of 2 miles radius. The western end of this curve being 300 feet from the river bank, thence by a straight line 1550 feet to the west bank of the river, thence curving to the north $63^{\circ} 30'$, in a distance of 4200 feet upon a radius of 3820 feet, it unites by a straight line of 1600 feet with the northern line, or Route No. 4. Line No. 1 crosses the river 330 feet above the bridge, and at the Worthington lot, so called.

No. 2. Passing north, the second line in succession, crosses the river 800 feet above the bridge, at Dr. Osgood's lot. It is straight from the point 3000 feet east of Armory Street, to the west bank of the river, a distance of 10,500 feet; thence it deflects $66^{\circ} 58'$ to the north, in a distance

of 4100 feet, upon a curve of 3509 feet radius, and there unites with line No. 1.

No. 3. The third line in succession, is a tangent to the curve at a point 3080 feet east of Armory Street, and from its origin, it is also straight to the west bank of the river, 10,580 feet, thence it deflects 66° to the north in a distance of 4400 feet, on a radius of 3820 feet, and there unites with Route No. 1. This line crosses the river at Mr. Hooker's lot, 1050 feet above the bridge.

No. 4. The fourth or northern, deflects from the main line, 3380 feet east of Armory Street, thence it is straight 3900 feet; thence it deflects $3^\circ 30'$ in a distance of 700 feet, upon a curve of 2 miles radius, thence it is straight 7500 feet to the west bank of the river, thence it deflects $62^\circ 40'$ to the north upon a curve of 4700 feet in length, and of 4298 feet radius, and there unites with line No. 1. This line crosses the river at Mr. Brewer's lot, and is about 1500 feet above the bridge, or 100 feet below Ferry Street.

No. 5. In addition to the above routes, a line was traced from the Garden Brook route, to a point in State Street, with the view of establishing a passenger depot, at or in the vicinity of that point.

The computations of both the distance and the cost of line No. 5, are made from the point at which this route departs from No. 1, to its junction with the same again, east of Main Street. The amount is, of course, to be added to the cost of either of the lines across the river, which may be adopted for the route. The propositions of the several proprietors of the lots offered for a depot, have been made upon the supposition that both the passenger and freight depots would be established upon their grounds. If either were to be placed elsewhere, their terms, of course, would be less advantageous.

The length of the line from its departure from Route No. 1 to State Street, is 4050 feet—of which 2725 feet is composed of curves of 1350 and 800 feet radius, respectively; and the balance of 1325 feet of straight line.

Cost of grading the same	-	-	-	\$5568	70
--------------------------	---	---	---	--------	----

Superstructure, (Bar iron)-	-	-	-	2673	12
-----------------------------	---	---	---	------	----

Cost of Land damages and ground for depot near Main Street	-	-	-	12,550	00
---	---	---	---	--------	----

If the depot were established farther north, say opposite Court Square, for land damages and depot				\$7750	00
---	--	--	--	--------	----

This line will be recognized by the Board, as the route proposed for their consideration by Henry Sterns, Esq., and by them ordered to be examined.

The following summary will exhibit a comparative view of these several routes, embracing the length, curvature, grading, bridging, land damages, cost, &c. of each. The land damages, including ground for a depot, have been furnished by the Agent of the Corporation; and his report upon that subject, now in possession of the Board, will have presented a full statement of the propositions of the different land owners through whose grounds the lines pass.

Summary of Routes from station 665, (a point below the head of Garden Brook,) to a point on West Springfield plain, one mile west of the bridge.

Statements.	No. 1.	No. 2.	No. 3.	No. 4.
Length of line (feet).	16.625	16375.	16172.	15800.
Grade (Maximum).	50.68	50.68	50.68	50.68
Aggregate length of curves (feet).	9825.	4450.	4400.	6000.
Total deflection in degrees.	91° 30'	68° 34'	66° 00'	66° 10'
Width of Con. River (feet).	1195.	1228	1259.	1335.
Greatest depth (feet).	14½	15.	13½	14
Mean depth (feet).	11.45	11 80	10.27	10.19
Angle of axis of bridge with that of river.	83° 30'	82° 43'	80° 52'	72° 45'
Grading.	19472.34	20662.00	21981.84	22499.40
Land damages, including ground for depot.	10570.00	14072.00	6245.00	7592.00
Connecticut River Bridge.	60984.00	62743.00	62484.00	62477.00
Total cost.	90826.30	97477.00	90710.00	92568.00

So far as we may be called upon to express an opinion in reference to a position for the depot, which shall best subserve the interests of the Corporation, we think we shall have performed our duty in that respect, when we say that a piece of ground of about 3 acres in extent, will be required, as nearly upon a level as may be; or where the grade of the road shall be sufficiently light to prevent the spontaneous descent of the trains—that it be established upon a portion of the track which shall be free from abrupt curvature, and that the lot of ground shall be about twice the length in the direction of the road, that it may be

transversely to the same. This being necessary to facilitate the entrance to such branches and sidelings, as may be required through the depot yard.

By the farther order of the Board, of the 22d of March, as indicated in the letter of instructions of the President, of the 25th of March, the road from East Brookfield to the Connecticut River was directed to be prepared and offered for contract, with the condition that the line should follow, either the north, or the south side of Garden Brook, as the Board might deem it expedient, to select the one or the other, for the route. In conformity thereto, this portion of it was advertised on the 1st of April, and the period specified for receiving proposals was limited to the 10th May; but it having been considered advisable to extend that limit, the contractors were notified that the allotment of the work would be postponed until the 1st June. Upwards of 500 propositions have been received from between 60 and 70 contractors; and those proposals which accorded best with the interests of the Corporation, have been accepted. Upon the two largest sections, where there was doubt as to the character of the excavation, the ground has been bored to a point below the grade of the road. These two sections are not yet allotted, being still under consideration.

We now proceed to the description of the operations on the west side of Connecticut river, and between it and the New York line. At the date of the last Report, the northern route, only, as was then stated, had been approximately located; and although numerous experimental lines had been surveyed upon the south route, no one line had been more critically examined, for location, than another. There was so much more space to be traversed by the preliminary surveys, than upon the north route, that the time consumed did not admit of locating. Since that period, this object has been attained, and thereby we have the means of making a full comparison of these two routes. In order to do this, it will be necessary to assume some point near the Connecticut river, which shall be common to both lines, and refer all the comparisons to it. For this purpose we shall take the east bank of the river, and compute the distance from it. The heights are all referred to the Bench Mark, at the eastern abutment of the bridge, being about 20 feet above the ordinary low water in the river.

It is well known that the Connecticut river is separated from the Hudson by an elevated range of mountains, which traverse the intermediate country from north to south; and further, that the waters of the Housatonic are divided from those of the Connecticut, by a lofty spur of the same range. This spur deflects from the parent chain, north of the source of the Housatonic river. Its course is east of south, or transverse to the route of the Rail Road.

This range has been examined from Washington on the north, through Becket and Otis, to Tolland on the south, embracing an extent of 22 miles from S. S. E. to N. N. W. By this examination we find the following to be the most favorable depressions for passing the main dividing ridge.

The Washington summit, elevated 1419 feet above the Bench Mark at Connecticut river; (20 feet above ordinary low water.)

The Spruce swamp summit, near the line between Otis and Blandford, is 1470 feet do.

Lyon's summit, in Otis, at the head of the north branch of Westfield Little river, 1484 feet do.

The Tolland summit, near Noyes's pond, 1392 feet do.

Having thus ascertained the heights of these several summits, the next question which presents itself for determination, is the route by which this elevation is to be overcome to the best advantage. We might premise, that by introducing a system of inclined planes, much distance would be saved; but knowing the strong objections which prevail in the community against their use, we have conceived it expedient to direct our attention to such other routes only, as would admit of the application of locomotive power.

Referring to a map of the State, it will be seen that the Westfield river, the Farmington river, and the Housatonic, mutually interlock their branches with each other. The western termination of the Western Rail Road being upon a tributary of the last-mentioned stream, and the intermediate summits being determined, it becomes the question then simply to select the most feasible route from one valley to the other. The Westfield, or Agawam river, is composed of two principal branches, called the Great and Little Westfield. The source of that branch of the former, which rises farthest west, is in Washington, while the Little West-

field has two branches, which rise at about the same distance west, viz. the northern near Lyon's, in Otis, and the southern at the Spruce swamp, near the Otis and Blandford line. The routes which have been surveyed, and approximately located for the north line are by Westfield Great river, and those for the south line, are by the valleys of both branches of the Little Westfield, and by routes entirely south of the same. To this general description, we may add the following statement: a straight line from Springfield to the western termination of the Rail Road, at the N. W. corner of West Stockbridge, passes through West Springfield, Westfield, southern part of Montgomery, northern part of Blandford, near the middle of Becket, middle of Lee, north part of Stockbridge, and of West Stockbridge. The distance is about 47 miles; the distance by the shortest travelled road, is about 50 miles. The greatest northing which the north route makes, is in Dalton, $9\frac{1}{2}$ miles from the straight line; the greatest southing which the south route makes, is in Southwick; but its greatest *distance* from the direct line is at Tolland, being at that point 8 miles from it. The lines, (north and south,) are farthest apart near the middle of the route, say at S. E. corner of Chester and N. W. corner of Tolland, 12 miles. We now proceed to the description of the lines which have been approximately located, both upon the north and south routes.

It has been stated in another part of this Report, that the four lines through the valley of Garden Brook, in their prolongation to the west, unite at a point about one mile from the river, on the West Springfield plain. From this point to Morley's bridge, across the Agawam river, a distance of 5 miles, the north and south routes are common to each other. Falling upon the Westfield river, at Ashley's mill, they continue at the margin of the stream two miles, and in a direction nearly west, to Tatham hill; thence curving to N. W. and again to west, they reach Morley's bridge. Throughout this distance, with the exception of some side cutting in red sand stone, at the Midneag falls, the ground is favorable, and not such as would be called difficult, even, at the falls. From this bridge, two lines were surveyed for the north route—one passing entirely north of the Westfield river, and crossing the Hampshire and Hampden canal at

Sackett's, and from thence to a point one mile above Tekoa mountain, and 8 miles west of Morley's bridge—the other crosses the Great and Little Westfield river, passes through the village of Westfield, a little south of the common or public square; thence by the south side of the low grounds of the Westfield river by Phelps's and by Clark's tavern, and crossing the river near widow Palmer's; it unites with the line by the north side of the river, near S. Bronson's, one mile above Tekoa mountain, as was stated in the Report of 15th January last.

Referring to that Report for a description of the several experimental lines which were surveyed for the south route, and numbered from 1 to 13, inclusively, we pass on to detail the route selected from among them for approximate location, with the introduction of such amendments of different portions of the same, as suggested themselves in the course of the re-examination.

From the village of Westfield, the south route passes over the plain to the Little Westfield, at the Powder mill, two miles distant, and crosses the river at that point; thence it curves gradually to the south, towards the valley of Munn's brook, (a branch of the Little Westfield) and crosses it below I. Shepard's; from thence, it turns farther south, and ascending the eastern slope of Sodom mountain, at a grade of 56 feet per mile, it enters the N. W. corner of Southwick; thence increasing the grade to 79.6 feet it pursues a course nearly south, to Loomis' gap (a depression in Sodom mountain formed by a branch of Munn's brook) 4 miles from the Powder mill; thence winding into this gap upon a curve of 1000 feet radius, it turns to N. W. and follows the direction of the valley of this branch to Farnsworth's; turning still farther to the north, it enters the S. W. corner of Westfield at Mount Pisgah, $3\frac{1}{2}$ miles from Loomis' gap, from Mount Pisgah it turns to the west, and again south, and enters the town of Granville; here it falls into the southern part of the valley of the Little Westfield, and continues parallel to it, near the Russell line, as far as Cobble mountain, on the east side of Stowe's brook, and 3 miles west of Mount Pisgah. At this point, the grade is 85 feet below the surface, and the excavation being in rock, a tunnel of about 600 feet would probably be preferable to a thorough cut. Crossing the deep ravine made by Stowe's brook, at an elevation above the

surface of the water of the same, of about 100 feet, the grade is reduced to 54 feet, thence it curves to the south, leaving the valley of the river, but turning soon to north again, to avoid the high ground west of Stowe's house, it crosses the Blandford line, and approaches the river again opposite Rowland Noble's at the junction of the north and south branches, and $1\frac{1}{2}$ miles N. W. of Stowe's. From thence to Beech hill, $2\frac{1}{2}$ miles, it winds along the side hill, crossing occasionally the line between Granville and Blandford, and crossing also the south branch of the Little Westfield, called Peeble's brook, the grade is here increased again to 80 feet, and the line is thrown from its west course at Ripley's, to one due south, to turn the point of Beech hill, and after passing this hill, it turns to N. W. and pursues that course 4 miles to the Spruce swamp summit, near the Otis and Blandford line, crossing the N. E. corner of Tolland. This is the principal summit of the route. It is elevated 1470 feet above the Connecticut river Bench Mark, and about 30 miles distant from it. An uniform ascent would give a grade of about 49 feet.

From the summit to Green Water pond in Becket, 11 miles, the line is very favorable, both in its direction and in its grades. It descends to Baird's tavern, near Nichols's pond, at inclinations varying from 2 to 28 feet per mile, and over a surface easily graded. At one mile west of the summit it passes through the village of East Otis; crossing at that place the outlet of Great pond, a tributary of Farmington river; thence by Parish pond, (the source of Farmington river,) and by Esq. Filley's, to Nichols's pond, in the southwest corner of Becket; from thence, to Green Water pond, the line ascends 8 feet per mile over favorable ground.

Green Water pond discharges itself into the Housatonic river in the town of Lee, through Green Water pond brook. This pond is the summit between the Farmington and Housatonic. The descent to the west from this summit is 79 feet per mile, through the valley of the outlet of the Green Water pond. The line crosses the ravine of this brook, below Sturgis's tavern, at an elevation of upwards of 100 feet above the surface of the water, and 5 miles distant from the pond; thence it winds to the S. E. around the point of East mountain, into the valley of Hop brook, crossing this stream in the N. W. corner of Tyringham, and

about a mile above its junction with the Housatonic and 3 miles south of Green Water brook, still descending 79 feet per mile ; thence it is level $\frac{1}{4}$ of a mile ; and thence the line, as approximately located, passes over a slight summit, but this may be avoided by pushing it a little farther north, or even crossing the river at South Lee, instead of the present crossing place, in the eastern part of Stockbridge.

From the present crossing place, one mile west of the boundary line between Lee and Stockbridge, the route passes over Stockbridge plain, north of the main street, and from thence to Furi's at the rocky ridge which separates the Housatonic from Williams's river (one of its branches) the line is nearly straight, crossing a bend of the river twice, to avoid a great curve to the north. But from Stockbridge plain to this summit, the line is both difficult and expensive, it crosses the river, necessarily, at heights of 25 and 40 feet respectively, and ascends at a grade of 55 feet per mile.—Near Furi's, 4 miles from the first crossing place of the Housatonic, in the eastern part of Stockbridge, the line enters the town of West Stockbridge ; and to pass through the gap at Furi's, two curves of 1000-foot radius each, are necessary. From this summit the line turns north, and following the side hill at grades descending to the west, of 38 feet, 20 feet and 7 feet per mile, it falls into the valley of Williams's river, and unites with the West Stockbridge Rail Road, at the proposed depot of the same, in the village of West Stockbridge, $2\frac{1}{4}$ miles east of the New York state line. From the depot west, the route pursues the located line of the West Stockbridge Rail Road very nearly, and joins the Hudson and Berkshire Rail Road at the state line, 62.38 miles from Connecticut river.

For a full description of the details of the route, embracing the grades, cuttings, fillings, curves, &c. reference is respectfully made to the accompanying Maps, Profiles, and Tables, and to the descriptive memoir of Mr. Morgan, appended hereto, under whose immediate direction, the approximate location, and a great portion of the preliminary surveys were made. An inspection of these maps, upon which all the lines are delineated, will bear us out in the assertion, that very extensive examinations have been made in reference to a "South Route." The results furnished by the same are now before the Board. They contain, we

believe, all the facts necessary to be considered, in comparing this route with the northern or Pittsfield route. We now proceed to a description of the same.

NORTHERN ROUTE.

This route is, essentially, the same which Mr. Baldwin surveyed for a Rail Road, in 1828, viz. by the valley of the Great Westfield river, and by one of its branches to the source of the same in Washington, thence by the principal branch of the Housatonic river to Pittsfield, and thence by a smaller branch of the same to a summit between the Housatonic proper, and Williams's river, one of its tributaries, thence to the N. York state line, at West Stockbridge.

From the junction, on the north side of the river, at S. Bronson's, of the two lines by the north and south sides of the Westfield, one mile above Tekoa mountain, and 14.30 miles west of the Connecticut, the route continues on the north side, one mile beyond, to a very abrupt bend of the river at Capt. Bronson's, necessitating at that point curves of either 1000 or of 800 feet radius as the line shall be thrown more or less into the bend of the river. The pass is a difficult one, and without encroaching upon the stream, or cutting off the bend entirely, by two bridges very oblique to the course of the river, the curve would be of too short a radius to be admissible. The grade is light, being about 15 feet per mile. From Capt. Bronson's to Finney's at the 2d mile, (counting from the junction of the two routes at S. Bronson's) the line follows the base of the east point of Shatterack mountain, a high rocky promontory, passing, in its course, over spurs, and intervening ravines, with a succession of curves, reversing from one to another, and not to be avoided without unwarrantable expense in the cost of construction. Near Finney's, the line crosses to the south side of the river at the "Narrows," to avoid the sharp turn which the stream makes, at Tuttle bend, $3\frac{1}{4}$ miles above Bronson's. By keeping the north side of the river at the bend, a curve of about 500 feet radius would be required. As it is, the alternative is to cross the river at the Narrows, upon a curve of 1900 feet radius, and continue upon the south side, at the foot of Tuttle mountain, and near the stream, re-crossing at the west point of Shatterack mountain, 500 feet above the east-

ern extremity of Tuttle bend. To accomplish this, even, compels the introduction of a curve of 955 feet radius. Immediately after crossing the river, at Tuttle bend, it becomes unavoidable to reverse the curve to one of the same radius, to turn the point of a lofty spur, which protrudes itself to the south. This done, the line falls upon the margin of the stream, at $3\frac{1}{2}$ miles, and continues to pursue it, to a point near Gould's mill, at $4\frac{1}{2}$ miles.

An attempt was made to obviate some of the above difficulties, by passing through the depression, south of Tuttle mountain, by the route of the present Albany turnpike, near Hawley's tavern; but it was found to be 105 feet above the river at the Narrows, in a less distance than $\frac{1}{2}$ of a mile.

From a point below Gould's mill to Chester village, at $6\frac{1}{2}$ miles, two routes were located, one on the north, and the other on the south side of the river. The line by the south side is the best and shortest. The grade and curves are also better. It will, by the estimate annexed hereto, cost \$5,900 more than that on the north side. This is caused by a single deep cut, and the expense of preserving the turnpike road. Uniting at Chester village, the route pursues the south side of the river to Porter's, at the 11 mile mark. The ground is very favorable, and the grades 31 and 33 feet respectively. The curves too, are comparatively easy. The line as at present located, crosses the river at Porter's, near the 11 mile mark, and again to the south side, at Wilcox's mill pond, near the $11\frac{1}{2}$ mile. This was done to cut off the bend of the river between these two points. Both these crossings may be avoided, by cutting through the rocky point of the mountain, which pushes itself down to the margin of the river, on the south side, between Porter's and Wilcox's. Previous to a definitive location, this line would, of course, be traced, and the comparative cost ascertained. The grade thus far has not exceeded 33 feet.

From Wilcox's pond to Fay's mill, the grade is increased to 41 feet, the line pursues the foot of the hill, and passing north of the old glass-house, it crosses the river between this latter point, and N. Root's, a short distance below Hubbard's tavern, at the mouth of Walker's brook, in Chester. At Fay's ($13\frac{1}{2}$ miles) the line recrosses to the south side, and the grade is raised to 71 feet, to correspond with the general declivity of the river. At $14\frac{1}{2}$ miles above D.

Bigelow's, the line passes over again to the north side, continuing to ascend at the grade last mentioned (71 feet.)

From this crossing place, to M'Elwain's tavern in Middlefield, a distance of $6\frac{1}{2}$ miles, is the most difficult and expensive portion of the route. The river is exceedingly crooked, and the mountains shut in on both sides, leaving scarcely room for a road, and requiring between Bigelow's and M'Elwain's, 15 crossings. The rocky points thrust themselves quite down to the stream, and no alternative is left, except a resort to very objectionable curvature, between these points. The grade here is also the steepest, viz. from 71 to 82 feet. At the curves of least radius, this has been reduced, to equalize, more nearly, the total resistance; still the far greater portion of the line must be laid at the grades specified above, for, notwithstanding the foot of the plane is elevated 48 feet above the river, yet the fall of the stream from McElwain's down, is so great that the line is now only $2\frac{1}{2}$ feet, above the sill of his mill dam, a less grade, therefore, without a corresponding increase of curvature, cannot be attained.

An examination of the Maps and Profiles, will convey a better idea of this portion of the line than any description; and the memoir of Mr. Childe, in the Appendix to this Report, exhibits a statement of the obstacles to be encountered. By referring to the Map, it will be seen, that at Capt. Root's, (or Rhinoceros point, as it is called) that from the northern extremity of the mountain, at Root's, to Bigelow's, the course of the river is south; while from the western extremity of the bend to Root's, it is north, and that to turn this sharp point, a curve amounting nearly to a semicircle, upon a radius of about 1000 feet, is indispensable. The river in this part of its course, performs a circuit of two miles; and the distance across the peninsula (an immensely high mountain) is between one half, and three fourths of a mile, only.

From McElwain's tavern to the summit, at Sibley's, in Washington, $3\frac{1}{2}$ miles, the line, after making a curve from west to nearly south, pursues a very direct course, at an inclination of 71 feet to the mile. The grading, in the last mile and a half, will be very expensive; the cut at the summit being 55 feet, and the filling on the east side of it 45 feet. Both these must be encountered, unless the curvature and grade be unwarrantably increased.

From the summit to Merriman's mill, or Plunket's factory, on a branch of the Housatonic river, in Hinsdale, and 5 miles from Sibley's, the line, as located, passes west of Mud pond, (the source of this branch of the Housatonic,) and thence by the valley of Hinsdale mill stream, to Capt. White's, through the Hinsdale meadows, from thence to Merriman's, over favorable ground. The grade within these 5 miles, in no case exceeds 22 feet, the greater part being nearly level. Before this part of the route is definitively located, it will be proper to examine a line, from the summit to Capt. White's, passing farther east, as represented upon the Map by a dotted line.

From Merriman's mill to Goodrich's, in Pittsfield, the first favorable point which occurs for crossing the Housatonic river, it is $5\frac{1}{2}$ miles. In this distance, the river descends 420 feet. The consequence, of course, is, that a steep grade, throughout this extent, must be resorted to. 1.89 miles is at 71.28 feet, and 3.48 miles is at 81.78. A heavy cut, involving the excavation of about 140,000 yards near the Hinsdale and Dalton boundary line, is the most serious obstacle in this portion of the route; and still this cannot be avoided without pursuing the immediate valley of the river from Merriman's, down, involving an increase of distance and of curvature. The grade would be diminished, but it is probable that the additional cost incurred by the increased distance, beyond the cost of making the cut at the town line, would reduce much of the advantage in this respect, which might be supposed would arise from thus extending the line. It will be proper, however, to have the river line traced, and the expense of a route in that direction ascertained before the line is adopted.

From Goodrich's to the village of Pittsfield, the line is very direct, with a slightly ascending grade. The surface is rather broken. It passes by Plunket's, and Munn's, the north side of ——— mill pond, and enters the village north of the Green or public square.

From Pittsfield to the New York line, the route is principally in the direction of the valley of a branch of the Housatonic, to a summit in Richmond, near Rev. Mr. Dwight's, and from thence to the Western termination, by a line rather transverse to the course of the streams, which fall into Williams' river, the branch of the Housatonic, up-

on which the village of West Stockbridge is situated. Between Pittsfield and the Richmond summit, two distinct routes have been approximately located. The first, or main line, as it is marked upon the Map, crosses the Pon-toosuc near the head of Pomeroy's satinet factory pond; thence it crosses North run near N. Sturgis's, thence south of his house, it falls into the valley of the Shaker mill stream, at Goodrich's, thence crossing two intermediate bends of this stream, it reaches the same valley again at Sterns's factory, ascending at 51 feet per mile to the Shaker's mill, thence at a grade reduced to 9 feet, it crosses two other bends of the same stream, and the western part of ——— pond, at the line between Pittsfield and Richmond; thence by a branch falling into this pond, it ascends to the summit at Parsons's, east of Rev. Mr. Dwight's.

Passing the summit, the line crosses a branch of Williams's river three times, occasioning a succession of cutting and filling at the spurs, and intervening ravines. The last crossing of this stream is at a point where the meadow, through which it runs, is upwards of 2000 feet wide, north of Leadbeater's. At Leadbeater's, the line falls into the valley of another branch of Williams' river, thence by Col. Rowley's and north end of ——— mill pond, to Griffin's in West Stockbridge, near the Richmond line, thence turning to the west, it crosses a small branch, and winds around the slope of the high ground, thence south of Arnold's, and unites with the south route at the New York state line.

By examining the accompanying Table, it will be seen that the maximum grade upon the line west of Richmond summit is 55.84 feet for a distance of nearly two miles; but reducible most probably, by modifying the line, to 45 or 46 feet. Four and a half miles is from 41 to 45 feet, and the balance 4.80 miles is less than 14 feet. The entire distance from Pittsfield to the state line is about $11\frac{1}{2}$ miles.

The second line from Pittsfield to the New York line crosses Pomeroy's factory pond, south of the main line, and thence turning farther west, it crosses the first line east of North run, and south of N. Sterns's, continuing nearly west, it unites with the main line, between Goodrich's and Sterns's factory. From the point of junction, another line was traced, which may be considered a continuation of the second line, passing farther north than the first or main

line, and nearer the Shaker village, thence S. W., until it united with the main line, near the Richmond summit. This line is made up of portions of three separate routes, marked A, B, and D upon the Map.

From Griffin's in Richmond, near the West Stockbridge and Richmond line, a route was traced to West Stockbridge village, about $1\frac{1}{4}$ miles.

The above lines for both the north and south routes, terminate at the West Stockbridge gap (so called;) a practicable line, it is said, may be found in Richmond across the dividing ridge between the waters of the Housatonic (or of Williams's river,) and of the Hudson, farther north than the Stockbridge gap. This information we gather from communications upon the subject, made to the agent of the Western Rail Road Corporation, by two gentlemen connected with the Albany and West Stockbridge Rail Road—one the superintendant, and the other a director.

They state that the gap at Richmond, as determined by the surveys of their Engineer, is 350 feet higher than that at West Stockbridge; and that it is about 3 miles north of the same; that the distance from the Rev. Mr. Dwight's (the summit of the Western Rail Road between Pittsfield and West Stockbridge) to this gap, is 3 miles, and that the inclination per mile from Mr. Dwight's to the summit, would not exceed 40 feet; that the distance saved between Connecticut river and Albany, if the north route should be adopted, would be 6 miles, making the distance from Richmond gap to Albany, $33\frac{1}{2}$ miles, if the route by Lebanon Church should be taken, or if by Lebanon Springs, ($1\frac{1}{2}$ miles farther north,) $37\frac{1}{2}$ miles; "that the route by the Springs," using the language of the superintendant, "being so much longer than that through the valley by the Church, admits of construction upon a grade of 40 feet to the mile, and less; but if that by the Church is adopted, the Church being $4\frac{1}{2}$ miles from the summit at the pond, a grade of 72 feet per mile, or more, must be adopted to go up; and about the same grade will go over the Richmond summit when reduced by a liberal cut. The route up the Lebanon valley, by the Church, and thence by the steep ascent of 72 or 78 feet to Richmond, can be made at a great saving of expense to our company, compared with the route by the Springs, probably \$100,000 and over."

How far these facts should weigh, in determining upon the main route west, is a question for the Board to decide. The information is embodied here, as we conceive it to be pertinent to the subject under consideration. We may farther mention that the grading of the Hudson and Berkshire Rail Road from West Stockbridge to Hudson, is stated to be three fourths completed; and that as yet, nothing has been done, in the way of construction, upon the Albany and Stockbridge road.

OF THE GRADES.

In order that a correct estimate may be formed of the difficulties to be encountered, in giving to either route grades which may be regarded as practicable for locomotive engines, it will be proper to bear in mind, that the entire line from Worcester to the N. York state line, must, of necessity, pass two very elevated summits, viz. that at Charlton, between the waters of the Connecticut, and those of the Blackstone, Quinebaug, &c. and the still more formidable one, which divides those of the Connecticut from the Hudson. Reviewing the line, we shall find that to overcome the Charlton summit, we have to ascend 470 feet in a distance of about 12 miles, and to cross the Connecticut river, (which at Springfield is only about 40 feet above tide water) it is necessary to descend in 42 miles, nearly 900 feet; thence again, to cross the mountain west of Connecticut river, we must ascend upwards of 1400 feet in 40 miles; and to reach the gap at West Stockbridge, we must descend again 600 feet in a distance of 23 miles.

Over such an extent of country, it would not, of course, be expected that, without resorting to inclined planes, and fixed engines, an uniform inclination, upon either side of these summits, could be obtained. In the absence of a system of planes, worked by stationary power, the fall of the several streams, which the routes pursue, determines the inclination or grade, to be given to the several stages of the road.

North Route. From Connecticut river to Hubbard's tavern, in Chester, the distance is 28 miles, and with the exception of 1.83 miles, at the western end, the grade does not exceed 33 feet. From Hubbard's to the summit at Sibley's, in Washington, 11 miles, the grade is from 70 to

82 feet, there being in this distance, but $\frac{1}{4}$ of a mile of a less grade than 55 feet.

From Sibley's to Merriman's mill, the distance is 4.65 miles; the highest grade is 22 feet, and the greater portion of it nearly level.

From Merriman's mill to the crossing of the Housatonic, at Goodrich's, in Pittsfield, the distance is 5.38 miles, with grades of 71.28 and 81.78, thence to New York line, it need not exceed 50 feet, and it may be, 45 feet.

South Route. From Connecticut river to Munn's brook, 11 miles, the grade need not exceed 33 feet. The first grade of 63 feet east of Munn's brook is to be avoided by winding around the point of the hill, near the mouth of the brook, instead of passing over it, as at present represented.

From Munn's brook to the Spruce swamp summit, 19.20 miles, the grades vary from a level to 80 feet per mile—10 miles being at 80 feet, and 3 at 70 feet. The balance of 6 miles varies from a level to 56 feet.

From Spruce swamp summit, west, to Green Water pond, 11.50 miles, the grade nowhere exceeds 28 feet and the greater part of it is less than 20 feet.

From Green Water pond to Hop brook valley, 6.65 miles, the grade is 79 feet.

From Hop brook to Stockbridge village, there is at present, a grade near South Lee, of 44 feet for 1 mile, but this may be avoided by throwing the line north, nearer the river.

From the village of Stockbridge to Fieri's summit, in West Stockbridge, 2.60 miles, the grade is 55.49 feet, thence to the New York line, nothing greater than 39 feet.

It results from the above, that if we fix upon 56 feet as a limit, that all the grades beyond that amount in the north line, are confined to the space between Hubbard's in Chester, and Goodrich's, at the crossing of the Housatonic, in Pittsfield, a distance of 21 miles, viz.

11 miles, Hubbard's to Sibley's from 71 to 82 feet.

4.65 " Sibley's to Merriman's Level to 22 feet.

5.38 " Merriman's to Goodrich's 71 to 81.78 do.

21.03 "

Upon the south route, we find the distance from the 1st grade exceeding 56 feet on the east, to the last on the west, to be 37 miles, thus,

19.20 miles,	Munn's brook to Spruce swamp,	Level to 80 ft.
11.50 "	Spruce swamp to G. W. pond,	Level to 28 ft.
6.65 "	Green Water pond to Hop brook,	79.28 ft.
<hr/>		
37.35		

The consequence is, that, if it should be necessary to use an assistant engine, upon the steep grades, its operation, on the north route, might be confined to a distance of 21 miles, while on the south route, it would necessarily extend over a space of $37\frac{1}{2}$ miles.

ESTIMATE OF THE COST OF CONSTRUCTION.

The computations for the estimate, have been made for a track of 20 feet in width, in the excavations, and for 16 feet at the embankments, with slopes of earth of $1\frac{1}{2}$ to 1, and for rock, 1 to 5. Bridge abutments are calculated for a double track. We find, by the data assumed, that the cost of grading and bridging the north route will be \$1,144,637.16, and for the south route \$1,120,823.14.

To the above amount we add 10 per cent., not for contingencies, as they are generally considered in an estimate, but to enable us to meet *probable* difficulties. In such an extent of mountainous country, we must expect to encounter obstacles, not anticipated at this time, and to be discovered only as they develop themselves during the progress of the work. As a prominent item we may mention rock cutting. The precise amount of which, cannot, of course, without repeated borings, be estimated with any degree of accuracy. Upon the north line, and caused perhaps by the action of the river, a greater proportion discovers itself, than upon the south; but it does not follow that the actual difference would be so great, if as much of the nature of the cutting were exposed to view, upon the south line. Upon the north route, we have provided in the estimate for the excavation of 247,000 yards of rock, and 17,000 yards loose rock. Upon the south line, the estimated quantity is 137,000 yards rock, and 87,000 yards loose rock. This is a large amount certainly, but it is a mountainous region throughout a great portion of the route, and we think it safer to make the addition stated, to cover not only this, but other difficulties, not to be foreseen. Accordingly we state the cost of grading and bridging as follows:

South Route \$1,232,905.45, or, per mile 19,762.21.

North Route \$1,259,100.87, or, per mile 19,952.79.

Comparative view of North and South Routes.

STATEMENTS.	S. Route.	N. Route.	Difference
Distance from Ct. River to N. York line,	Ms. 62.43c	63.101	0.666
Elevation of principal summit,	Ft. 1470	1419	51.0
Elevation of grade at do.	Ft 1440	1398	48.0
Number of summits,	5	4	1.
Total amt. of ascending grades fom east,	Ft. 1655	1542	113.0
Equated distance,	Ms. 149.543	144.263	5.280
Total deflection in degrees,	4931.5	4441.5	390.
Length of curved line,	Ms. 34.041	34.414	0.373
Length of straight line,	Ms. 28.397	28.690	0.293
Maximum grade,	Feet 80	82.18	2.18
Grades from 0 to 30 feet per mile,	" 31.490	33.483	1.993
" " 30 to 40 "	" 3.376	5.113	1.738
" " 40 to 50 "	" 1.061	6.382	5.321
" " 50 to 60 "	" 5.747	2.481	3.266
" " 60 to 70 "	" 4.090	0	4.090
" " 70 to 80 "	" 16.665	7.748	8.917
" " 80 to 82 "	" 0.	7.897	7.897
Total amount of grades above 71.57 ft.,	Ms. 16.665	8.902	7.763
Cost of grading and bridging per mile,	\$17,965.65	18,138.90	173.25
Total cost of grading and bridging,	1,120,823.14	1,144,637.16	23,814.02
Add 10 per cent. to above cost of grading and bridging per mile,	19,762.21	19,952.79	190.50
Total cost of grading and bridging,	1,232,905.45	1,259,100.87	26,195.42

RESULTS OF THE COMPARISONS.

From these comparisons, it results that the actual distance, by the south route, is $\frac{2}{3}$ of a mile less than by the north—that the principal summit is 51 feet higher upon the south route, than upon the north, and that the additional elevation of all the summits, upon the south line, amounts to 113 feet more than upon the north, and that the equated distance corresponding thereto, is 5.28 miles, against the south line—that the amount of curved line, by the north route, exceeds that by the south, by $\frac{1}{3}$ of a mile, but that the whole deflection, which is the full measure of all the curvature, is 390° , or 30° more than an entire circle, greater upon the south route, than upon the north—of grade less than 40 feet, the south route has 34.86 miles; and the north route 38.60 miles, or 3.73 miles, in favor of the north route; from 40 to 82 feet the south has 27.56 miles, the north do. 24.50, difference in favor of the north route 3.06 miles; above 71.57, the south route has 16.66, and the north route 8.905, difference in favor of the north route, 7.63.

Hence it appears that the equated distance by the north line is less than that by the south line—that there is a greater amount of *low* grades, and a less amount of *high* grades, by the north line than by the south—that the distance between the eastern and western extremities of the high grade, is less upon the north route, than upon the south, and finally that the curvature is less.

Upon the south route, the actual distance is $\frac{3}{4}$ of a mile less than by the north line—the maximum grade is 2.18 feet less than by the north, and the estimated cost of grading and bridging \$26,195.42 less.

The two first items are of small amount, and we attach but little importance to the estimated difference in the cost of grading the two lines. We think, also, that it should not receive too much consideration from the Board, in deciding upon the route. A small error in estimating the quantity of rock, even, at particular points upon either route, would counterbalance the difference. But independently of the cost, we consider that the table of results bears us out in awarding the preference to the northern route, and accordingly we recommend, respectfully, that it be adopted.

The surveys and approximate locations from Stony hill to Pittsfield, were made by Mr. Childe, and his assistant, Mr. Foster. The several routes through the Garden brook valley were also made by Mr. Childe.

Those from Pittsfield to the New York state line, were made by Mr. Potter, and his assistant, Mr. Bartlett. The surveys upon the south line, and the approximate location of the same, were made by Mr. Morgan and Mr. Barton, with the occasional assistance of Mr. Williams, Mr. Featherstonhaugh, and Mr. Roots, as levellers.

Respectfully submitted,

GEORGE W. WHISTLER,
W. H. SWIFT.

On a careful perusal of the foregoing Report and a comparison of statements with results, I fully concur with Messrs. Whistler and Swift.

WM. GIBBS McNEILL.

Boston, December 30th, 1837.

MAPS, PROFILES, TABLES, &c.

1. Map exhibiting the location from East Brookfield to Stony hill, in Wilbraham. Scale, 1000 feet to an inch.
2. Profile of the same.
3. General map of the country between Stony hill, and Tekoa mountain, exhibiting the located line to Armory Street, and the lines approximately located, from Ashley's mill to Westfield, by the south route, and to Tekoa mountain by the north route. 1000 feet to an inch.
4. Profile, Stony hill to Tekoa mountain.
5. Map of the several lines, through the valley of Garden Brook, across the Connecticut River, and to Ashley's mill, on the Westfield River. Scale, 12 inches to a mile.
6. Profiles of the same.
7. Map of the country traversed by the south routes from Westfield to the Otis summit. Scale, 1000 feet to an inch.
8. Map of the country traversed by the south route, from the Otis summit, to the New York line. 1000 feet to an inch.
9. Profile of the approximate location of the same.
10. Map of the approximate location of the north routes from Tekoa to Pittsfield. 1000 feet to an inch.
11. Map of the same from Pittsfield to the New York state line. 1000 feet to an inch.
12. Profile of the same. 1000 feet to an inch.

TABLES.

A contains a synopsis of the south route, as approximately located, from the Connecticut river to the New York line, exhibiting the length, ascents, descents, grades, excavation, embankments, bridges, culverts, and estimated cost. It also contains the length of each curve, with its corresponding radius.

B contains the same of the north route.

C contains the cost of grading the 5 lines across the Connecticut River from Armory Street to West Springfield meadows.

APPENDIX.

No. I. Mr. Childe's descriptive Memoir of the north route.

No. II. Mr. Morgan's descriptive Memoir of the south route.

APPENDIX NO. I.

Springfield, May 29th, 1837.

TO CAPT. W. H. SWIFT, ENGINEER OF THE WESTERN
RAIL ROAD.

SIR,

The northern route to the State line through Pittsfield, is the continuation of the Garden Brook route from Station 872 (14½ miles from Connecticut river,) where the estimate for that route was terminated. The line as traced follows the valley of Westfield river, and that of the Western branch to the highest summit, a little north of the boundary line between Washington and Hinsdale—40 miles from Connecticut river; thence through Dalton and Pittsfield village to a second summit in Richmond, 57¾ miles from Connecticut river; whence it descends to and joins the Hudson and Berkshire Rail Road at the state line in the north west corner of West Stockbridge; the entire distance from Connecticut river is 62.925 miles. The features of the country traversed are truly exhibited by the maps and profiles.

From Westfield to Washington is strictly a transverse mountain valley, worn down by the action of water, until the bed of the river, through the whole distance, is either the original rock "in place," or paved with blocks and boulders too large to be frequently moved by the force of the current.

From Washington to Pittsfield is a second valley like the former, though less broken. Five miles of it through Hinsdale being nearly level. From Pittsfield to Stockbridge, is a third valley like the former two, elevated in Richmond and the west part of Pittsfield, forming the 2d summit, and draining water east and west. This valley is broadest of the three and undulating.

Counting from Station 872 at Tekoa mountain, the distance to the Hinsdale summit is $25\frac{1}{2}$ miles, and the ascent of grade 1211 $\frac{1}{2}$ feet. Owing to the unequal descent of the valley, and the impracticability of making a road surface of its bottom lands, only 374 $\frac{1}{2}$ feet of this ascent can be overcome in the first $13\frac{1}{2}$ miles, giving an average of 27.7 feet per mile, the maximum grade being 41.39 per mile. The remaining ascent of 837 feet is distributed as equally as possible through the next 12 miles, giving an average of 69 $\frac{3}{4}$ feet per mile; the maximum grade being 82.18 feet per mile.

From Hinsdale summit to the crossing of the Housatonic in Pittsfield, the distance is $9\frac{1}{2}$ miles, and descent of grade 452 $\frac{1}{2}$ feet. Three and three fourths miles of this distance through Hinsdale meadows, admit a descent of 32 $\frac{1}{2}$ feet only, averaging 8.66 feet per mile, leaving the descent of 420 feet to be effected in $5\frac{1}{2}$ miles, giving an average of 76.38 feet per mile, the maximum grade being 81.78 feet per mile.

From the crossing of the Housatonic river the grade slightly undulates; descending 5 feet in $1\frac{2}{3}$ of a mile, then ascending 15 feet in $2\frac{1}{2}$ miles to Pittsfield village, thence descending 5 feet in about $1\frac{1}{2}$ miles to near K. Strong's, distant from Housatonic river 3.8 miles, where commences the ascent to the second summit which is attained in the distance of 4.88 miles by ascending 120 feet; average per mile, 24 $\frac{3}{4}$ feet—maximum grade, 45.04 feet per mile. From the second summit to the state line is 5.17 miles, descending 214.32 feet—average 41.45 feet per mile—maximum grade 55.84 feet per mile.

Total of ascending Grades from Tekoa	1346 $\frac{1}{2}$ feet.
“ descending “ “ “	676.72 “
“ distance	48.617 miles.

Counting from Connecticut River

Total of ascending Grades from Tekoa	1537 feet.
“ descending “ “ “	686.72 “
“ distance	62.925 miles.

The first consideration, in making the location, has been to render the grades as uniformly ascending, or descending, and consequently as easy as practicable, without increasing the distance, or in any case the degree of curvature; and secondly, wherever a short curvature could not be avoided, the grade has been reduced as much as possible. The result shows the

distance from Connecticut river to Pittsfield, to be about 2.20 miles, and on the whole distance from Connecticut river to the State line, 2.85 miles shorter than Mr. Baldwin's line. And although the grades are generally easier than might have been anticipated, from the experimental survey, yet the ascent from Root's to McElwain's, is steeper than was indicated by Mr. Baldwin, occasioned entirely by making the line straighter than his, by frequent crossings of the stream, which reduces the distance nearly $\frac{1}{4}$ a mile between those points.

For a full description of the approximately located line relative to the choice of ground, curvature, crossings of river, &c. see, in connection, the plan and profile. Commencing at 872, the line passes along the western base of Tekoa mountain, on pretty good ground, to the short bend of the river, east of Capt. Brunson's, around which two lines have been traced, uniting at Station 937 $\frac{1}{4}$. The first begins at Station 911, passes the bend by a 7° curve, which, at Station 926 $\frac{1}{2}$, is reversed into one of $5\frac{1}{2}^{\circ}$ which continues to 936 $\frac{1}{4}$. The second line begins at Station 909 $\frac{1}{2}$, and passes the bend by $5\frac{1}{2}^{\circ}$ curve, which, at Station 928, reverses into the same, ending at 937 $\frac{1}{4}$. The first throws half the width of the road into the water, on the length of 200 feet. The second throws the whole road into deep water, on the length 460 feet, and increases the cutting considerably, in front and east of Brunson's house. The estimated cost of the second is \$6670,21 more than the first. Either of these lines would be preferable to the passage of this bend by two bridges, especially as the grade is horizontal from Station 904 to 955. From Brunson's to Finney's the line curves continually to the right or left, and passes three rocky spurs, with intervening meadows. The curves cannot be improved without increasing the rock cutting at Stations 944, 957, 969, and by building into the river at Station 940. To this point, Finney's, a route on the west side of the river seems out of the question. Continuing the route up the river, and looking at Tuttle bend, there appears no alternative, but to cross the river, at the "Narrows," and follow up the base of Tuttle mountain, as the only practicable way of passing that bend, with a curvature less than 10° , and without heavy rock cutting. The bridge at the bend, may be of two spans of 120 feet each, and so constructed that the road may curve while crossing it. The bridge at the "Narrows" will be crossed on a right line; both bridges being about 80 feet above the water.

The curvature from 1031 to 1080.60 is necessarily short, being composed of 6° , $6\frac{1}{2}^{\circ}$ and 5° curves; but the grade ascends only 10.77 feet per mile. The impossibility of avoiding Tuttle bend, by passing South West of Tuttle mountain, by Hawley's tavern, is rendered certain by a test level, which gives the highest point of the valley 105 feet above the river at the "Narrows," and at a distance of less than $\frac{1}{4}$ of a mile therefrom.

The ground is excellent from Station 1080.60 to 1116.85, whence two lines are traced, one on each side of the river, uniting at Chester village. That on the south side is 375 feet shorter, is straighter, admits of a more favorable grade, and requires but one bridge, at a favorable point for crossing the river below Gould's mill, but is estimated to cost \$5899.12 more than the other, which requires two bridges, one over the main or north branch of Westfield river—the other over the west branch at the village. Both of these crossings are much exposed to floods. The principal obstacles on the west side are, the high point at Gould's mill, and the turnpike. To cut through the one, and preserve the other, requires the stated excess of cost, over the other line.

From the 7 mile mark, the ground, for some distance is about the same on both sides of the river, but between Babcock's and Fisk's, the curvature would be much the greater on the N. E. side. This, joined with the difficulty of crossing the river at Fisk's, which is necessary, and an unfavorable crossing place, at the 7 mile mark, gives a decided preference to the South West side, where the line is traced, and no bridges required.

From Fisk's to N. Root's the ground is very favorable, and the line of easy curvature, requiring 3 bridges from 8 to 11 feet above the water.

The crossings at Porter's and Wilcox's may be avoided however, by running nearer Stebbins's house, and cutting through the two rocky points, opposite the crossing places.

The cost of doing this should be estimated before a final location is made. The curvature would be greater, and grade the same.

The crossing above the old glass-house, is indispensable, also that above Fay's mill.

Up to this point the whole cost from Connecticut river, 27 $\frac{1}{2}$ miles, is \$337,103.09, averaging \$12,147.86 per mile, including Connecticut river bridge.

From Fay's mill the ground rises rapidly, and by crossing

again, above D. Bigelow's, the highest ground is taken, without running on the mountain side, for the purpose of gaining height at the beginning of the short curve around Rhinoceros point, which is 54° , and nearly a semicircle. The grade through this curve, is, in consequence, reduced to 54.77 feet per mile. In like manner, the grade through the next two curves, around and from Walnut hill, is slightly reduced. The length of these curves is one mile—radii 1348.23 and 1432½ feet. The two crossings, each 50 feet above the stream, cannot be avoided, but the amount of embankment at Station 1740, and between Stations 1750 and 1762, may be reduced, by moving the 1st curve a few feet to the right.

At Station 1778 commences the steepest grade on the northern route, 82.18 feet per mile on the length of 4.016 miles, terminating at Station 1990, a little way above McElwain's tavern. Although the foot of this grade is 48 feet above the river, yet the latter falls so rapidly from McElwain's, that the grade passes but $2\frac{1}{2}$ feet above the sill of his mill dam. It will probably be necessary to lower this dam, or remove it altogether, not for the purpose of materially reducing the grade, for that is impossible on account of its being so little above the bed of the stream from McElwain's to the next crossing below, which crossings cannot be avoided, but to render the bridge secure which crosses the river and dam without raising the grade. The flood marks along here are about 5 feet above ordinary water, as shown upon the profile. The most costly and difficult pass upon this most difficult section of the route is from Middlefield and Becket road, to Clark's saw mill. Two high mountain spurs of solid rock shoot by each other, separated only by the narrow bed of the stream, which winds between, receiving the waters of Cold brook upon the north. Two lines were traced here from Station 1826 to Station 1883, and the maximum curvature adopted was 3° , radii 1910 feet, but the amount of rock cutting (70 feet in depth on both) appears too formidable. The estimate, therefore, has been made upon the lightest part of each, assuming 4° curves and passing the river at a point between the crossing of the two lines. The connection of parts of the two lines is dotted on the map. The passing of this point involves the construction of four bridges, all of which are short, 70 and 90 feet span. The space between Stations 1990 and 2002 presents a favorable stopping place, the only one between

Hubbard's in Chester and the summit in Hinsdale, 9 miles from the former, and 4 from the latter.

After turning nearly a right angle at McElwain's, by a curve of 2292 feet radius, the course is very direct to the highest ground at Sibley's. Through half this distance the ground is very favorable, but the directness of the line involves heavy embankments on the upper half, at and above Crane's. These embankments, however, ought not to weigh much against a direct line, inasmuch as a heavy cut must be made at Sibley's—whether there be embankments to receive the spoils or not. It is proposed to turn the road from Deming's to Crane's, across the meadows, and pass it and the stream under one bridge, or else turn it up the hill to the right, and pass it over the Rail Road.

The latter may be cheaper, as the meadow ground is held exceedingly high. From Station 1677 below Capt. Root's to 2168 west of Sibley's, is, in every respect, the worst part of the whole route. Distance, 9 $\frac{1}{2}$ miles. Estimated cost, \$447,708.14. Average per mile, \$48,480.88.

From Sibley's the line passes along the west side of Mud pond, and turning to the N. W. through a ravine, passes a point of the hill near Simmons's, which forms the summit of the road, thence into the valley of Hinsdale mill stream, which is one of the head streams of the Housatonic river. The bottom of this valley from 26 mile mark to near Capt. White's, except two gravel knolls, is soft mud, from 1 to 12 feet deep, resting upon hard white gravel. In many places, piling may be required, in all $\frac{3}{4}$ of a mile.

Another line from Mud pond to Capt. White's is proposed and dotted on the Map. It passes over harder and less valuable ground, is more direct, and would have been traced but for the serious difficulty of crossing the N. W. part of Mud pond, the bottom of which is reported to be from 20 to 25 feet of soft mud. This, however, may not balance its apparent superiority in all other respects over the present line.

From Capt. White's, the ground is very favorable to Merriman's mills, and the line is most of the way straight.

The line from Watkins's should be thrown a little south, which may be done without any additional cost, and thereby avoid one curve of 4° deflection at the 29 mile mark, and shorten the artificial channels east of that curve which will be required to keep the river the north side of the road.

From Merriman's mill, the rapid descent to the Housa-

tonic river cannot be avoided. It may probably be made a little more gradual by an increase of cost and distance by leaving the south mountain a little below the Mill village, following the west branch of the river and crossing it somewhere north of the Dalton churches, thence either north of the Pittsfield road by Merrill's tavern and two patches of wood to Pittsfield village, or else by crossing the road and river near the boundary of Dalton and Pittsfield, join the present line at or near Plunkett's. It would be well, perhaps, to have a line traced in this direction before making a final location.

The deep cut at the boundary line of Dalton and Hinsdale is the only serious obstacle on the present line, which is traced on the generally even surface of the south mountain by T. Benedict's to Station 2638, where it turns from the mountain by a 1° curve and takes the most direct course over undulating, but otherwise favorable ground, to Pittsfield village.

Mr. Baldwin suggests the removal of Merriman's mill dam, but this cannot be done without buying his saw-mill and Plunkett's woollen factory, which stands on the opposite side of the road and stream; besides, its removal will not ease the descent, unless the depth of the cut at the boundary line be proportionally increased; and if this be expedient, the grade may be reduced to one uniform descent of 76.38 feet per mile, without disturbing the mill dam. The draining of Hinsdale meadows is not of much consequence, as the water in no place ever rises more than 3 feet above the surface. The only other possible mode of graduating this descent, and which seems the most promising, is, to strike a higher point at T. Benedict's, keeping round the mountain farther to the south, and crossing the old Pittsfield road a little south of H. Porter's, thence by a gentle curve across the south point of the meadow, cross the road again near Swain's, keeping the left bank of the Housatonic river to White's mill, where the river must be crossed, and the line continued around south of Pittsfield village, about in Baldwin's track, crossing the Pontoosuc river, and joining the main line of the present approximate location near Stevens' factory. The principal objections to this route are, indirectness and curvature, and the necessity of being from 15 to 25 feet lower between Swain's and the crossing of the Pontoosuc, than at corresponding points of the present line. In fact, there is but one reason for, and many

against either of the changes suggested. The best apparent mode of easing the descent is, to cut at the boundary line of Hinsdale and Dalton deep enough, if funds will permit, to make the grade uniform.

The line crosses North Street in Pittsfield 1000 feet north of the green, passing through F. Allen's barn on the east, and Wellbridge's house on the west side (both of which must be moved,) thence following the side hill, intersects West Street on the point of the hill in front of Mrs. Childe's house. The cutting at North Street is about 14 feet, allowing it to be bridged over the River Road. West Street, at the crossing, may be cut down to a level at small cost, and be much improved by the change. From this point, Mr. Potter continued the location.

The country being so broken from Pittsfield to the Richmond summit, three several lines have been traced—1st. The main line (which is on the map and shaded on the profile) crosses the Pontoosuc river 27 feet above the water, and the valley of North run by a heavy embankment: thence passing south of N. Strong's and C. Goodrich's, crosses the shakers' mill stream twice at an average height of 35 feet above the waters, (both of these crossings require heavy embankments,) thence ascending rapidly, passes the high ground west of Sterns' factory by a long cut of 45 feet greatest depth, from which it enters upon the general summit level, still gently ascending over favorable ground excepting one heavy side hill cut at Station 252, to the highest point at Station 318.

2d. Line A, which crosses the Pontoosuc near Pomeroy's factory, beyond which it turns to the North by a 2° curve, crosses the valley of North run at a favorable point, and by a curve south of 1910 feet radius, joins the main line at Station 100, near C. Goodrich's.

3d. Line B, which begins at Station 70 of A line, and by a 1° curve passes 100 feet north of C. Goodrich's to Station 98½—thence by a straight line it crosses the stream at a favorable point and joins the main line at Station 119.

4th. Line C, which begins at 137 main line, crosses the stream at Sterns' factory village, passes the high ground east of the stream by a 30 feet cut, and by a second crossing joins the main line again at Station 180.

5th. Line D, which begins at 112 main line, crosses the stream at a favorable point, and by a $2\frac{1}{2}^{\circ}$ curve, takes the direction of Silver Run hollow, from which it passes by a

25 feet cut on to the general summit level, and joins the main line at Station 296, being 950 feet longer than the main line. Taking A line from West Street to Station 70, and the whole of B line to its intersection with the main line, and comparing the line thus formed with the corresponding part of the main line, there seems to be a decided preference for the former, for with the same grades, it requires less cutting and filling east of the Pontoosuc, less filling by one half across North run valley, and gives equal quantities of cutting and filling between this valley and the meeting of the lines at Station 117, which is not the case on the latter—there being nothing in that between the same points but heavy embankments too far distant to be filled from the cut at Sterns' factory. The curvature on the former too, is less than on the latter, having in view the adoption of the main line from Station 117, but the distance is 125 feet longer.

In continuation from 117, the main line is taken to the summit for the 1st estimate, disregarding C line, which requires two bridges and the removal of one house and 3 barns at Sterns' factory, and is therefore deemed less favorable than the opposite part of the main line, although the cutting on it is somewhat less.

The 1st route then, from North Street in Pittsfield to the Richmond summit, is made up from A line, B line, and the main line, the distance being 6.336 miles—maximum grade 45.04 feet per mile, and total cost \$120,389.60, averaging \$19,000 per mile. By comparison, the ground passed over by D line appears much more favorable than that of the corresponding part of the main line—that is, it gives a much better place for crossing the stream at Station 118, requires less filling between 118 and 136—and less cutting by more than one half between 146 and 192. Half of the latter distance on the south side of Silver run hollow requires filling, which will be supplied from the cut at the Shaker village road, while the corresponding cut on the main line would be entirely wasted.

The maximum grade on this line is 1.92 feet less than on the main line, and the ground taken over the general summit level much better. Believing therefore, that D line and parts of A and B lines will form the best route from Pittsfield to the summit, a tolerably direct junction has been assumed between B and D lines by the introduction of E

line on a radius of 5730 feet, making the length of this 2d route from North Street to the summit 6.524 miles, 950 feet longer than the 1st. Estimated cost \$105,498.11—averaging \$16,170.77 per mile—\$2,829.23 per mile less than the 1st route. From Richmond summit to the State line, the main line is the only one traced, and is taken as the continuation of either of the preceding routes which have been estimated. Its course is all the way over very broken ground, but to Col. Rowley's tolerably direct. From the latter point, it should be moved north on to higher ground, which will diminish the curvature and bring the grade nearly, if not quite, to an equal descent of 41.68 feet per mile, the maximum being now 55.84 feet per mile.

The distance from Richmond summit to the State line is 5.170 miles.—Estimated cost \$65,688.29—average per mile, \$12,705.66.

Finally, the whole estimated cost from Tekoa on the best route, that is by D line, is \$957,949.60—average, \$19,740 per mile.

This is on the supposition, that the Pontoosuc turnpike be shut up between Root's and McElwain's. If it be inexpedient to do this, as it is most probable, an additional sum of \$14,722 must be added to the above amount, making \$974,671.60, which gives an average of \$19,970.32 per mile.

Counting from Connecticut river, by D line, the whole distance is 63.104 miles, and estimated cost \$1,144,637.16—averaging \$18,138.90 per mile.

Seven tenths of the rock cutting on the route is Gneiss, Mica Slate and Sandstone. The two former preponderate throughout the whole route. The latter is chiefly found through Pittsfield, Richmond and Stockbridge. Serpentine, Syenite and Hornblende-slate are found below, at, and above Capt. Root's in Middlefield. Granite at several points: chiefly below Clark's saw mill; and west of Washington, quartz rock, mostly in the form of boulders.

Suitable stone for nearly all the masonry may be taken from the cuts near at hand.

The actual cost for foundations will be very small; for all the heaviest bridge masonry will rest in the natural rock or hard gravel, which form, in most cases, the banks and beds of the rivers.

Very Respectfully,
JOHN CHILDE.

APPENDIX, NO. II.

Springfield, May 28th, 1837.

TO CAPT. W. H. SWIFT, ENGINEER OF THE WESTERN
RAIL ROAD.

DEAR SIR,

Having now completed all the surveys, from which there could be the least probability of improving the South Route, from Westfield to New York line, I have selected, with much care, the best possible route. A full statement of the various items of expense, with reference to the Map, and Profile, has been made out. I have traced the route by a blue line, on the map of experimental lines, where it will best serve to show the efforts that have been made, and that no ground has been neglected, where there was the least possibility of success. It was owing to the anxiety, I was aware you felt, to have the investigation most thorough, that I have been longer engaged, than I at first anticipated. I believe it will be admitted that no pains have been spared, to effect this object. My party encountered much severe weather, in February and March, and were obstructed by deep snows, in Becket and Blandford. It was from other obstacles, however, which are every where met with in the mountain, that my task has been rendered difficult.

Commencing at a point, on the lot designed for the Hudson Rail Road depot, in West Stockbridge, I proceeded on favorable ground, till near Fieri's Marble quarry, where a ridge of rock obstructs the pass into Stockbridge. This being formed by the southern extremity of the mountain, curves of 1000 feet radius become necessary, and a cutting of considerable extent through the rock. I descended from this summit into Stockbridge village, at a grade of 50 feet per mile, and for the most part by a straight line; which, though involving the necessity of high bridges, and embankments across the valley formed by the Housatonic river, is on the whole, a cheaper line than could be found in any other direction. I did not, in proceeding eastward,

find it necessary to vary essentially from the experimental line, till I reached Hop brook, where, in passing on to the East mountain, a very formidable embankment became requisite, and as it could not be brought within limits, which could rationally be considered practicable, I extended the line 70 chains, by passing farther up the valley, and, by this means, succeeded in making a much better profile, ascending to Green Water pond, without exceeding 80 feet per mile.

The space between Green Water pond, and the Otis summit, which was run by Mr. Barton, presents very favorable ground—the line being direct, and not exceeding in grade, 25 feet per mile. After leaving this summit, in Otis swamp, it appeared possible to find a pretty direct line, if by any means practicable ground could be kept upon, through the valley of the Little Westfield river. My line was very encouraging, till I had descended two miles into the the ravine, through which the main stream passes. A dotted line in blue indicates this route, which however, I was forced to abandon. For, although I found myself right in conjecturing, that by bridging the stream frequently, very good ground would be attainable, the courses round certain rocky points could not be brought within admissible limits, without the most enormous expenditures. I returned, therefore, 8 miles, to my line, and following the side hill near Peeble's brook, I pursued the line marked on the map, taking all possible advantage, in crossing this stream, as well as the one above Bates' Tannery, where a deep ravine divides the hills. The soil in this vicinity being a fine gravel, intermixed with a large proportion of sand, the depth of these fillings are not very serious obstacles. After passing Elihu Stow's, the most difficult part of my route presented itself, and I was doubtful at one time, whether I could reach Westfield plains, without exceeding 80 feet per mile. My first attempt was by the Flat lot, and Reuben Noble's, and after again running, fruitlessly, four miles, I found the point of Sodom mountain impracticable, at so great an elevation, and could I have passed round this point, my grade was directly in all the ledges, on the east side. I returned, in consequence, to Flat lot, extending my line farther down the Little River valley, and succeeded in avoiding all these difficulties, and the increased distance bringing me 80 feet lower, I was enabled to reach the plains,

when less than half the distance had been passed on the east side of the mountain before referred to; all these circumstances have tended to lengthen the south route, and increase the curvatures; the distance from New York state line, to the intersection of Mr. Williams' line, with which I have connected the present survey, is 54.018 miles, and the whole distance to Connecticut river, 62.387 miles. The deepest cut is 64 feet, gradually diminishing to 50 feet in the space of 400 feet. At Cobble gap, the grade runs for a short distance 85 feet below the surface of the rock, consequently a tunnel for 4 chains is preferable to an open cut. Had the line been carried through the gap, the cutting would not have exceeded 50 feet, but the line would have been thrown, in that case, by a sharp curve, to the edge of a precipice, which is now avoided.

The ravine at Stow's brook is 100 feet deep, diminishing, however, in the distance of 2 chains, to 60 feet. There is also a ravine in Lee, formed by Green Water brook, 110 feet below grade. This extreme depth extends only 50 links, and at 5 chains is reduced to 50 feet. In carrying forward the survey, I have been particular to take numerous cross sections, and though in a final location, it might be expedient to vary the line, the quantities estimated would not essentially differ. In rock cuttings and other bad places, I have kept in view this consideration, always making ample allowances. There are but 5 large bridges on the route—three of 100 feet span, across the Housatonic river, and one of 40 feet, across Munn's brook. An examination of the map and profiles, in reference to this statement, will give a tolerably correct idea of the general character of the route; and it will be seen at once how extremely difficult it has been to accomplish the object of the survey, without transgressing those rules, on which the essential value of Rail Roads depends. In running the various lines you have directed, I have never omitted to consider thoroughly, every possible mode by which advantage could be taken of the ground. And I feel confident in the assertion, that the whole space, on which we have bestowed so much labor, has been most scrupulously, and critically examined.

Very respectfully,

Your Obedient Servant,

RICHARD P. MORGAN.

A *Synopsis of estimated cost of Grading and Bridging South Route from Con. Riv. to the western line of the State.*

Sta- tions.	Length.		Total Length.	Ascent of Grade.		Total As- cent.		Desc. of Grade	Total De- cent.		Elev. of Gr. ab. C. R. Bench Mark.		Excavation.		Embank- ment.	Bridge length Feet.	Masonry Perches.		Grub- bing. Feet.	Amount.	REMARKS.
	Feet	Miles.		Feet.	Feet.	Feet.	Feet.		Earth.	Rock.	L. Rock.	Abut- ments.	Cul- verts.								
2700		8.224					78.07	72.00												128516.09	This amount in- cludes that part of Mr. Child's L. which extends from Con. R. to commencement of this Table.
2692	1700	0.322	8,740	6.89			88.97	78.58	21.07						9873.56					1863.41	
2680	1200	0.227	8,966				84.96	80.89	Level						7707.35					2546.31	
2622	5800	1.098	10,065	76.89			154.96	151.89	63.70	3798.30					18032.90					3786.91	
2544	7800	1.477	11,543	87.00			165.07	147.00	6.54	101435.84					2699.66					21301.53	
2420	19400	2.348	13,891	131.86			196.93	288.98	36.15	160176.00					160868.99			1600	39516.08		
2050	37000	7.007	20,898	557.89	776.75		854.92	897.57	79.69	307263.46	68814.90				29093.45			14800	173979.09	3533 yds in Tun- nel, estimated at \$5 per yard.	
2008	4200	0.795	21,693	43.72	820.47		908.54	898.59	54.00	91870.68	8166.00				4491.00						
1974	3375	0.639	22,332	11.40	831.87		909.94	897.99	17.85	98730.64					248491.86			800	66271.55		
1869	10525	1.993	24,326	79.72	911.59		989.66	914.67	40.00	136882.02					239866.08			1500	73316.48		
1710	15900	3.011	27,338	240.88	1152.47		1230.54	1252.55	80.00	136882.02	6148.10	12326.51			2330.02						
1688	2200	0.416	27,754				1230.54	1230.55	Level.	4725.44	1481.00				13034.79			3000	4551.55		
1530	15800	3.992	30,746	209.44	1361.91		1439.98	1451.99	70.00	146333.35	300.00	18380.25			86732.92						
1420	11000	2.084	32,830				1403.04	1397.04	17.73	134415.93		101406.41			541.20			3300	30460.24		
1330	900	1.704	34,534				1354.99	1372.99	28.20	72774.72		79649.06			91.59			400	17049.27		
1200	1300	2.462	36,997				1349.99	1344.99	2.03	30160.53		93562.84			159.42			4050	20620.13		
1059	14100	2.621	39,668				1292.03	1281.03	21.70	21231.54		74805.83			636.62			2730	46598.31		
927	13200	2.500	42,168	19.50	1381.41		1311.53	1311.53	7.80	96471.12		50884.68			30.60			20350.73			
576	35100	6.647	48,815				784.56	774.56	79.28	331918.00		508.97			523.37			3820	115349.59		
536	4000	0.757	49,573				784.56	776.56	Level.	607.38		8006.38			121.41						
460	7600	1.439	51,012	35.08	1416.49		819.64	853.64	24.32	23428.36		65028.49			194.73						
404	5600	1.061	52,072				772.62	764.62	44.31	38574.43		46185.49			52.66						
349	5500	1.041	53,114				764.63	758.63	7.65	43196.52		13679.40	100	595.00							
315	3400	0.644	53,758	10.00	1426.49		774.63	746.63	15.53	5477.87		13835.24			2305.40						
178	13700	2.604	56,362	144.49	1570.98		919.12	942.12	55.49	134821.56	6598.99	355400.66	200	4527.00				500	87448.25		
1041	7350	1.382	57,745				17861.69		38.92	17861.69	28092.67	180650.47			150650.47			1550	90545.15		
*140																					
501	5425	1.028	58,773				65547.16		20.35	65547.16	5310.67	32045.41			47.38					20544.99	*140 chains is the distance from the State Line to the Hudson Depot in W. Stockbridge.
86	10425	1.976	60,749				24212.94		7.35	24212.94	113.33	98988.93			85.69			200	8610.50		
0	8600	1.628	62,387	9.00	1579.98		20790.83		5.52	20790.83					62.22					4532.73	
							2292344.88			124955.35		36293.61	370	6811.29	6445.52	38280	112082.31				

Recapitulation of Grades, Elevation, and Cost, from Westfield to State Line.

South Route from Westfield, via Otis and Lee, to the State Line.	Elev. of Termini.		GRADES.										Total Length.		Elev. of Termini.		Cost of grading, ab. & bridging.		REMARKS.
	Gr. at ab. C.R. do. Bench.	Feet.	From 0 to 10 Level, ft. per mile.										Miles.	Feet.	Gr. at ab. C.R. do. Bench.	Feet.	Dolls.		
			10	20	30	40	50	60	70	80									
EASTERN.	72	78.07	1.400	11.084	3.367	7.164	3.375	1.061	5.747	4.090	16.665	54.014	337.00	330.93	992706	69	\$18378.68 per mile. (From West. to S. line,) or \$17965.65 per mile from river to state line.		
WESTERN.	841	339.00											432.00	430.00					

Table of Curves in South Route—Approximate Location.

1°		2°		3°		4°		5°		6°		42' 48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		48'		4	
----	--	----	--	----	--	----	--	----	--	----	--	---------	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	-----	--	---	--

RECAPITULATION.

0° 42'			0° 48'			1°			1° 10'			2°			2° 10'			3°			3° 10'			4°			5°			6°			Distance.		Total Distance, Straight Miles.
Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.	Dist.	Dist.	Rad.				
8185.5	7182.5					57.30	3820	2865									2292	1910																	
1.079	1.117	7.064	0.2651	0.7765				6.818	0.4450					5.246	0.3551																				
								0.7433						0.1610																					
																															</				

Synopsis of estimated cost of Grading and Bridging North Route from Tekoa mountain to the State line.

Sta- tion.	Length. Feet.	Miles.	Total length.		Total Ascent. Feet.	De- cent of Grade. Feet.	Total Feet.	Elev. of G. ab- ove River Bench.	Elev. of G. ab- ove Ct. R. Bench.	Grade per mile Feet.	Excavation, Cubic yards.		Embank- ment, Cub. yds.	Bridge, length Feet.	Masonry, Perches		Grub- bing, Feet.	Amount. Dolla. Cts.	REMARKS.	
			Feet.	Miles.							Earth.	Rock.			Abut- ments & side- walls.	Culverts & side- walls.				
From 872 to 904	3200	0.606	9.00		9.00			180.5	197.436										Sta. 872 is the same as 862 of Synopsis A	
955	5100	0.965	1.571					189.5	192.039	14.85	23780.26	2938.68	9027.01			23.00	900	9974.09	of G. Brook Route, from Stony hill to Tekoa mountain.	
1031	7600	1.439	3.011	40.00	49.00			229.5	222.692	27.78	20284.69	7331.65	41766.64			1174.80	600	17323.25	This distance for grade, curvatures, and bridging is less, but	
1080	4900	0.928	3.939	10.00	59.00			239.5	243.043	10.77	39064.18	10877.19	26436.00	370	895.40	2387.20	2130	33517.92	by east side of river.	
1200	14000	2.651	6.590	72.50	131.50			312.00	305.073	27.34	103321.55	8130.78	55295.81	250	1809.60	704.00	3480	17163.07		
1411.5	19180	3.626	10.217	120.00	251.50			432.00	433.760	33.09	71402.43	202.08	42338.10			1908.50	40.40	23240.97		
1490	7850	1.486	11.704	46.50	298.00			478.50	471.50	31.27	8683.87		22959.23	295	873.20	146.20		12463.54		
1587	9700	1.837	13.541	76.00	374.00			554.56	560.25	41.36	19789.98	2115.54	17015.01	130	204.00	344.60	500	11928.68		
1677	9000	1.703	15.246	122.00	496.00			676.30	655.50	71.57	1900.89		53766.19	900	1737.60			2145.49		
1704	2700	0.511	15.757	23.00	524.00			704.50	672.33	54.7	11952.20	150.00	52195.64	380	5754.30			29716.35		
1724.9	2030	0.366	16.153	32.50	556.50			737.00	726.25	81.71			18425.94			39.50		16343.98		
1778	5310	1.005	17.158	77.50	634.00			814.5	802.10	77.20	36845.62	25488.22	153123.99	290	8368.00	5425.40	2600	92000.87	* 90 feet of this same length of common	
1990	31200	4.016	21.773	330.00	964.00			1144.5	1143.48	82.18	113115.19	62552.63	156136.66	900	16958.30	484.80	4170	16440.91	length of common road bridge at sum-	
2009	1200	0.227	21.301	5.00	969.00			1149.5	1146.99	22.00			5129.11	50	204.00			2433.82	mit.	
2168	16600	3.144	24.545	225.00	1194.00			1374.5	1400.00	71.56	144463.04	106204.49	5849.15	349834.30	*300	5063.20	186.00	6730	15277.91	Highest point at
2320	5200	0.934	25.529	17.50	1211.50			1392.0	1418.77	17.76	44949.60	4685.50	24502.73	25	127.60			14678.42	Washington summit	
2372	5200	0.984	26.513					1371.5	1367.50	22.00	20837.40	2431.27	17864.02	72	238.80			7567.45	at 1418.776 feet above	
2372	10000	1.894	28.407					1370.0	1370.00	79	56327.85		19731.05	30	66.00			16317.81	Con. River Bench, or	
2414	4200	0.795	29.202					1360.0	1371.90	12.57	15789.72		9144.72					3870.14	ordinary low water	
2514	10000	1.894	31.096					1225.0	1235.30	71.28	153292.08	809.19	19477.00	15488.08				43316.60	\$229.74 included for piling, etc. thro'	
2698	18400	3.485	34.581					940.0	922.25	81.78	17530.29	11552.51	167823.08					39232.96	Hugdale meadows.	

SYNOPSIS OF ROUTES—(Continued.)

Stations.	Length.		Ascent of Grade.	Total Ascent.	Desc. of Grade.	Total Desc.	Elev. of Elev. of		Excavation.		Embankment.	Bridge es.	Masonry.		Grubbing.	Amount.
	Feet.	Miles.	Feet.	Feet.	Feet.	Feet.	G. ab. ground	Per	Earth.	Rock.	Cubic yds.	length	Abutments & side walls.	Feet.		
2710	1200	2.28	34,809				935.	931.50								
2831	12100	2.29	37,101	15.00	1298.50	5.00	950.	964.08	97852.51		16547.55	100	1120.00	293.10		754951
2908	7700	1.45	38,561				945.	939.80	79930.32		79808.68	*28	560.00	293.10		2178615
3034	12600	2.36	40,946	107.50	1334.00	5.00	1052.50	1072.85	120144.02		10276.99	144	1322.80	394.30		2816498
3056	3200	0.60	41,553				1062.50	1052.50	8327.75		31003.80	130	424.00	253.40	1100	5439118
3108	4200	0.79	43,348	10.00	1344.00		1062.50	1062.50	9326.53		2290.50	126	288.00	65.40		389395
3166	5800	1.09	43,447	2.50	1346.50		1065.00	1067.85	30475.04		17920.16		9926.02	65.40	4500	2170140
3280	11400	2.15	45,606			90.00	975.	972.50	124408.74		10158.32	172	38.00	402.10		1933679
3354	10400	1.96	47,575			110.00	865.	848.95	65464.55		80526.96	100	761.60	76.80	2950	2806489
3439	5500	1.04	48,617			14.32	850.68	850.68	41665.48		12578.25		670.00			3028531
Total.			48,617						1493422.78	335073.71	167005.02	4122	47154.40	18172.50	43830	97684111

Extract from Synopsis 'A' of Garden Brook Route, from east bank of Con. River to Sta. 865+3 at Tekoa Mountain.

From 110, east side Cl. R. to 865 or 872 above.	14.308															169965154
From Cl. R. to S. Line.	62.925															1146806165
do, including "D" line.	63.104															1823497
Total cost of which is \$1,144,637.16, keeping open the Pontotoc Turnpike, averaging per mile.																18136190

Second Line from Sta. 1080, east side of Westfield River, to Chester Village.

From 1080	8600	1.62	1,639	42.			282.00	278.50	52851.27	2600.00						1347784
to 1168							312.50	308.07	61644.24	1683.33						2355777
to 1223	5775	1.03	2,722	30.50	72.50				114495.51	4253.33						3703561
			2,722													

Second line from Sta. 3908 "A" line, through "D" line, to 3166 of Main line.

to 3088	12000	2.27	2,273	98.00			1043	1072.	75990.05							1347784
" 3129	9300	1.74	4,015	24.00	122.00		1066	1084	12.57	69103.59						2355777
" 3175	5550	1.05	5,066			2.00	1065	1067.85	23959.64							3703561
									174953.32							

REMARKS.—* North Street bridge in Pittsfield, 40 ft. wide. † Common road bridge. ‡ Common road bridge. Level of Hudson and Stockbridge R. For other particulars concerning this line, which is by the north side of Westfield River, see Synopsis "A" accompanying Report of Jan. 15, 1887. Line east of River to Chester Vt. is 875 feet longer than that on west side. § Common road bridge. This line is 999 feet longer than main line between same points.

RECAPITULATION.

ROUTES.	Elev. of Termini above Connect- cut River Bench.	Elev. of Grade at do. above Con. River Bench.	GRADES.											Total Length. Miles	Elev. of Ter- mini ab. & be- low Worcester R. R. Depot.	Elev. of Gr. at do. ab. & be- low do.	Cost of grading and bridging		REMARKS.
			Level, 10 ft.														Dolla.	Cts.	
			0 to	10	20	30	40	50	60	70	80	90	100						
North Route from Tekoa mountain, via the Pontocue and Pittsfield, to the State Line.	Eastern, 197.426 Western, 850.680	180.5 850.680	1.572	6.744	5.151	5.529	5.113	6.382	2.481	7.748	7.897	48.617		Eastern, —215.980 Western, +437.264	232.916 437.264	976.841	11	\$20-492.00 per mile.	
Total cost by substituting "D" line as above, Total cost by substituting 2d line as above,																			
19,740.00 19,623.00 "																			

Total cost by substituting "D" line as above,
Total cost by substituting 2d line as above,

959,949 62
954,088 50

19,740.00
19,623.00

Table of Curves in the approximate location from Tekoa Mountain, via Pittsfield, to the western line of the State.

Table of Curves in the approximate location of																				
STATIONS.		Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	Rad.	REMARKS.
10		110	110	130	20	210	30	310	30	40	410	40	50	510	60	610	70	710	45'	
5780		4984	3820	3274.28	2865.	2292	1910	1763	1637.1	1538	1433.5	1348.33	1273.3	1146	1041.5	965.52	895	830	764	8895
From 872 to 883																				
882																				
889																				
894																				
904																				
911																				
916																				
936																				
943																				
947																				
953																				
963																				
966																				
970																				
974.35																				
983.35																				
993.35																				
1002.35																				
1010.35																				
1012.85																				
1017.85																				
1023.35																				
1027.35																				
1033.60																				
1037.10																				
1056.10																				
1072.35																				
1080.60																				
1089.35																				
1092.85																				
This curve may be changed to 5 1/2 degrees, on radius of 1041.8, by building into the river, at an additional cost on the whole of 2d grade of \$6870.31.																				

TABLE OF CURVES—(Continued.)

[illegible]

RECAPITULATION.

[illegible]

Synopsis of the cost of grading five Depot Lines across Connecticut River.

STATIONS.			Length.		Total of Length.		Amount of Ascent.		Total of Descent.		Total of Elev. of Gr. ab. ground.		Excavation.		Embankment.		Bridge length.		Masonry.		Grubbing.		REMARKS.
		Feet.	Miles.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Con. B. ab. C. R. Bench.	Mark.	Earth.	Rock.	L. Rock.	Cubic yds.	Feet.	Feet.	Abut. ments.	Cul. vards.	Feet.	
From 665 To 694		2900	0.549	0.549	27,840	27,840	91,026	63,186	101.134	35072.61		466.34											6839 04
751		5700	1.079	1.628	54,720	82,560	8,466	6,587	50.688	18931.90		29570.29								261.12			6829 15
761		1000	0.189	1.818	0.000	82,560	8,466	16.584		363.44		2950.26											556 70
818		5700	1.079	2.897	10,032	92,592	1,566	2,496	9.2928		36158.81	1225											69534 81
836.72		872	0.165	3.062	5,546	92,593	3,980	5,764	33.5808		4652.10												907 14
Totals of L. Line.		16173	3.062	3.062	92,593	92,593	91,026	63,186	101.134	54251.95		73697.84	1225							261.12			84465 44
From 665 To 751		8600	1.696	1.628	92,560	82,560	8,466	8,892	50.688	53152.52		31186.00											Including \$300 for cutting down Army and ditching m. and ditching Average haul 408 feet.
761		1000	0.189	1.818	82,560	82,560	8,466			6179		2585.46								193.28			491 15
818		5700	1.079	2.897	10,030	92,592	1,566	5,469	9.2928	194		34054.49	1150										67254 26
831.25		1325	0.250	3.145	7,950	92,592	6,384	5,764	31.680		7595.68												1443 05
To. of 2 L. Line.		16625	3.148	3.148	7,950	92,593	91,026	63,186	101.134	53215.26		65431.63	1150							193.28			80256 34
From 665 To 694		2900	0.549	0.549	27,840	27,840	63,186	78,932	50.688	25072.61		466.34											5515 84
751		5700	1.079	1.628	54,720	82,560	8,466	6,028	50.688	27497.38		29431.04								276.16			7330 62
761		1000	0.189	1.818	82,560	82,560	8,466	1,451		885.99		1367.62											300 74
818		5700	1.079	2.897	10,032	92,592	1,566	4,613	9.2925		40138.12	1225											71307 76
823		500	0.094	2.992	3,350	92,592	1,584	5,664	35.376		2372.36												Average haul 700 feet.
Totals of 3 L. Line.		15800	2.992	2.992	92,592	92,592	91,026	63,186	101.134	53465.96		73765.48	1225							276.16			84976 40
From 665 To 694		2900	0.549	0.549	27,840	27,840	63,186	59,853	50.688	14993.56		1166.71											3748 20
751		5700	1.079	1.628	54,720	82,560	8,466	8,044	50.688	24053.75		30196.89								31.0680			Including \$200 for cutting down Army St.
761		1000	0.189	1.818	82,560	82,560	8,466	1,451		67.03		2275.88											466 37
818		5700	1.079	2.897	10,032	92,592	1,566	4,613	9.2928		36786.01	1200											79284 13
838.75		1075	0.203	3.101	6,656	92,592	5,090	5,691	32.691		7595.68												Average haul 568 feet.
Totals of 4 L. Line.		16375	3.101	3.101	6,656	92,592	91,026	63,186	101.134	39114.34													157 697
From 723 To 750		2700	0.511	0.511	29,133	29,133	6,213	6,173	36.9712		11863.69												83405 53
759.35		935	0.177	0.688	29,133	29,133	6,213	6,173			3909.11												Average haul 1300 feet.
756 to 772		1600	0.303	0.991			8,466	8,266		172.53		4840.04								11.5			7900 64
773 to 779.50		750	0.141	0.133	2,253						481.75												Including \$1771.28 for Depot em.
Totals of 5 L. Line.		5985	1.133	1.333	2,253	2,253	2,253			172.53		21034.59								11.5			7900 64

*Office of the Western Rail Road Company,
Boston, January 1st, 1838.*

THOMAS B. WALES Esq. PRESIDENT OF THE
COMPANY.

SIR,

The Board of Directors having "ordered that the Engineers be instructed to furnish plans of the various styles of Superstructure, with estimates of the expense thereof"—we have the honor, accordingly, to submit the following Report.

The superstructure, or *rail-way*, constructed as it may be in either mode we shall describe, may be considered as a frame work placed upon the road bed; the stability, and durability of which, will, of course, depend on its *foundations*, and the nature of the materials composing the *rail-way*.

The foundations we shall suppose to be, as they would be, alike in either case—their principal object being the equable support of the frame-work, and its protection from the influence of frost—to guard against the effect of which, in our latitude, it would be necessary, wherever the natural soil was the least argillaceous, or such as would retain and collect moisture, to excavate the road bed to the depth of say $2\frac{1}{2}$ feet (below which the frost would very seldom penetrate) and to consolidate thereon, in lieu of the material excavated, sand, or pure gravel—or in lieu of either to construct masonry for the support of the sleepers or cross ties. Experience has shown that the better plan is to depend on sand, or gravel, rather than broken stone, or rubble masonry. It is much cheaper, generally, and in all cases equally efficient.

The foundations being alike, however the rail-way may be constructed, their cost will not enter into a comparative estimate. The actual cost of preparing them would of course depend on the character of the ground traversed by the Rail-Road—for instance, in excavations through rock, or soil other than clay, the sleepers would be laid immedi-

tely on the road bed ; or in other words, where sufficient protection was already afforded against the effects of frost, from the favorable character of the road bed, we should not of course, resort to artificial foundations.

We shall suppose, however, in order not to be disappointed in the actual cost, that throughout the whole distance, artificial foundations shall be necessary. The cost then for excavating say 8 feet wide, and 3 feet deep ; for procuring and depositing the suitable material, may, we think, then be safely assumed at \$2346.66 per mile, per single track, and to this, if we add the cost of longitudinal sills of pine, hemlock, or such other timber, as may be most conveniently procured, the object and utility of which would be equally to sustain the rail-way, especially on embankments, and to facilitate the re-adjustment of the rails, when they shall have been deranged from the settling of the road bed or other causes ; we must add for this item, say, \$646.80 per mile and the total cost of the foundations would be \$2993.46 per mile.

We have said that the rail-way, or superstructure, may be regarded as a frame work, composed of the rails proper, tied together, at intervals, by the sleepers, or cross-ties, and as variously practised, the weight, form, and consequent strength of these Rails, determine the intervals at which they are tied, or supported. For instance the common flat bar, or rail, of ordinary dimensions, requires a continuous support, and is laid upon string pieces of wood or stone, and these stringers are tied together (in order that they may not spread or lose their parallelism) at intervals, dependant on the dimensions and strength of the stone or wood of which they are composed.

This, however, is so poor a substitute for the several descriptions of rail way, which you are accustomed to see in this section of the country, and as we think, by unanimous consent, so unsuitable to your purposes, that we hardly think it necessary to dwell longer on it, than merely to state, that inferior as it is, the only saving in first cost (ultimately it is more expensive) would be in the diminished cost of the rail itself, and which would probably amount to about \$2500 per mile—that is supposing the rail to consist of the flat bar, and the wooden string piece.—The defects of this mode of construction are obvious.

Many modifications of the iron edge-rail might be enumerated, but as on a careful comparison of all of them, and after much reflection, aided by our own experience, and that of others, we are not enabled to improve on the T. rail, such as has been adopted on the Boston and Providence Rail Road—the Taunton Rail Road—the Stonington Rail Road—and lastly on the *second* track of the Lowell Rail Road; we shall submit to you estimates of cost, on the supposition of its use. The construction of these several Rail Roads, vary essentially in no particular, save that on the Boston and Lowell Rail Road stone sleepers have been substituted for the wooden sleepers, which from necessity were elsewhere adopted. The eventual saving, we doubt not, will prove the exercise of a wise economy in imitating the example of the Lowell Rail Road where stone can be procured at a reasonable cost. We submit, however, the two following estimates.

1. Cost of a single track of Rail way, of a similar construction with the Stonington Rail Road, (which differs from the Boston and Providence Rail Road in its continuous *longitudinal sills*) the weight of the rail being 55 lbs. per lineal yard, or 86.42 tons per mile, to wit,

1. Foundations, - - - - -	\$2993.46
2. 1760 sleepers 7 feet long × 8 inches thick, - - -	528.00
3. 704 cast iron chairs (or splicing plates) 10 lbs., - -	352.00
4. 9,152 spikes at 8 cts. per pound, - - - - -	366.08
5. 86½ tons of iron rails at \$60 per ton, - - - - -	5185.20
6. Laying rails, including excavation of trenches, &c. \$2 50 per rod, - - - - -	800.00

\$10,224.74

To this must be added, the cost of transporting the materials, an estimate of which cannot, at this time, be made with accuracy. It will be perceived, however, that it will not affect the comparative cost materially. Our own impression is, that in the above estimate we shall be found to have amply provided for all expenses; that is, that the cost of foundations will be so much less than stated, (because they will by no means be required throughout the whole distance) that the surplus will suffice for all contingencies.

2. Cost of a single track of rail-way per mile, similar to the *second* track of the Boston and Lowell Rail Road, and based upon the actual cost experienced on that Road.

1. Foundations, (the longitudinal sill was omitted on the Lowell Road,) its cost is \$646.80 per mile, and is herein included, - -	\$2,993.46
2. 1760 stone sleepers, viz. 352 for the joints, at \$2.50 each, - - - - -	880.00
1408 for the intermediate ties, at \$1.50 -	2112.00
3. Fitting and moving sleepers at 50 cts., -	880.00
4. Spikes as before, - - - - -	366.08
5. Iron rails as before, - - - - -	5185.20
6. Laying rails at \$4 per rod, - - - - -	1280.00

13696.74

A similar remark may be made respecting the item of transportation, which has in this case also been omitted. It would be enhanced because of the greater weight of the materials, and we are much inclined to think, that the difference in cost per mile between the two modes would vary but little from the sum of \$4,000.

Detailed statements and specifications will be prepared and furnished whenever the Board shall require them, on which would be based the contracts for rails, and other materials.

Respectfully submitted by

WM. GIBBS McNEILL,
G. W. WHISTLER,
W. H. SWIFT.

И О Т Ч М А Б

И О Т

СОВЕТНИК

